BIOLOGY

Paper 9700/11
Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**A**	21	**C**
2	**D**	22	**A**
3	**C**	23	**C**
4	**C**	24	**A**
5	**D**	25	**C**
6	**C**	26	**D**
7	**B**	27	**A**
8	**B**	28	**B**
9	**D**	29	**B**
10	**B**	30	**D**
11	**D**	31	**D**
12	**B**	32	**D**
13	**A**	33	**B**
14	**A**	34	**A**
15	**C**	35	**B**
16	**A**	36	**D**
17	**B**	37	**C**
18	**D**	38	**C**
19	**B**	39	**A**
20	**B**	40	**D**

General comments

The mean score was 20.86 (52.16%) and there was a very good spread of scores, the standard deviation being 6.43. Six questions were answered correctly by 75% or more of candidates – **Questions 9, 15, 19, 24, 28 and 30**. Eleven questions were difficult; 40% or fewer candidates answered **Questions 1, 11, 12, 13, 16, 20, 29, 31, 32, 35,** and **39** correctly.

Comments on specific questions

Question 1

The relative difficulty of this item was due to many candidates not appreciating that if you use appropriate stains the chromosomes and nucleolus are frequently visible under a light microscope. However the cell surface membrane is too small to see unless you use an electron microscope.

Question 2

It is encouraging to note that many candidates are able to use standard form when converting between mm and nm.

Question 3

Less able candidates do not realise the difference in function between the rough and smooth endoplasmic reticulum.

Question 4

Calculation of magnification remains a problem for over half of the less able candidates.

Question 5

At least 60% of less able candidates did not know that the feature of all prokaryotes is the presence of ribosomes. Candidates should be taught that prokaryotes divide by binary fission.

Question 6

Candidates should have used a microscope to observe sections of leaves and it is expected that they should know the relative positions of xylem, phloem, palisade and spongy mesophyll.

Question 7

More than half the less able candidates incorrectly thought that heat should be used for the Biuret test.

Question 8

This question was well answered by the more able candidates who realised that the products would be glycerol and an unsaturated fatty acid molecule.

Question 10

Over 75% of less able candidates did not realise that the sub-units of proteins are non-identical amino acids.

Question 11

Whilst nearly 60% of the candidates knew that hydrogen bonds are weak and disulfide bonds strong only 16% correctly knew that ionic bonds are also weak.

Question 12

Again 65% of the candidates knew that in collagen, having covalent bonds between adjacent molecules and each three-stranded molecule being held together by hydrogen bonds, helps to give great tensile strength. However, only 13% realised that, without having every third amino acid being small, the three-stranded molecule would not be close enough to form hydrogen bonds.

Question 13

Most candidates worked out that the primary, secondary and tertiary orders of structure were involved. However, since there are two polypeptide chains, each including 3 amino acids from the active site, the quaternary structure must also be involved.

Question 16

Most candidates appreciated that the water potential of the solution in Y was less negative than that in W. However, since the cells at X (in solution Y) lost water, whilst the same cells in solution Y gained water, the cells at X in solution Y have a less negative water potential.

Question 18

A significant number of candidates did not realise that a haploid cell cannot undergo a reduction division.

Question 20

It is possible for any cell in the body to contain mutated DNA. Cancer cells divide rapidly and as such would have a very short interphase.

Question 21

Less able candidates find the events of DNA replication and transcription unclear. The correct answer is **C**.

Question 22

If no two amino acids adjacent to each other are the same, then you would only need 4 types of tRNA to translate the mRNA.

Question 23

This was only well answered by the most able candidates.

Question 25

The majority of the less able candidates are unable to clearly distinguish the features of xylem and phloem.

Question 26

Only the most able candidates were able to work out that pressure potential is never negative and water potential will approach zero in the conditions described.

Question 27

The majority of the less able candidates are unable to clearly recognise the events in translocation through phloem.

Question 29

A large number of candidates were unable to extract the data correctly from the graph.

Question 31

Many candidates did not seem to understand what exocytotic vesicles are. Goblet cells use exocytotic vesicles to secrete mucus.

Question 32

This was poorly answered. In order for the oxygen to reach the haemoglobin in a red blood cell it must pass through both cell surface membranes of an alveolus cell, both cell surface membranes of a capillary cell and one cell surface membrane of a red blood cell.

Question 33

Whilst almost all the candidates realised that the surface area would decrease, less than half knew the volume would not change.

Question 34

Many less able candidates incorrectly selected answers that included water contaminated by sewage.

Question 35

Candidates must carefully read the question. Since avian flu is caused by a virus it cannot be treated by antibiotics. Killing all poultry does not prevent humans from spreading the disease.

Question 37

The most able candidates correctly knew the function of memory cells.

Question 38

Candidates continue to find it difficult to differentiate between ecological terms. This was a description of a niche.

Question 39

It is expected that candidates should know that microorganisms are very small (in the range of micrometres). Therefore **B** and **D** could be eliminated. The most loss of leaf area occurred in the nets with a net size of 7 mm. Therefore anything that is small enough to enter through this net but not through a net of 0.5 mm would cause the breakdown of the discs, in this case this must be the earthworms and beetles.

Question 40

Only just over half of all candidates were able to work out that there were 6 trophic levels present.

BIOLOGY

Paper 9700/12
Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**A**	21	**C**
2	**D**	22	**C**
3	**D**	23	**A**
4	**C**	24	**A**
5	**C**	25	**A**
6	**C**	26	**C**
7	**D**	27	**D**
8	**B**	28	**B**
9	**B**	29	**B**
10	**D**	30	**B**
11	**B**	31	**D**
12	**A**	32	**D**
13	**B**	33	**D**
14	**B**	34	**C**
15	**A**	35	**D**
16	**A**	36	**B**
17	**C**	37	**A**
18	**B**	38	**D**
19	**D**	39	**C**
20	**B**	40	**A**

General comments

The mean score was 24.73 (69.33%) and there was a very good spread of scores, the standard deviation being 6.52. Fifteen questions were answered correctly by 75% or more of candidates – **Questions 3, 5, 6, 10, 11, 14, 16, 17, 20, 24, 29, 33, 34, 35, and 39**. Six questions were difficult; 40% or fewer candidates answered **Questions 7, 12, 13, 15, 18** and **40** correctly.

Comments on specific questions

Question 1

The relative difficulty of this item was due to many candidates failing to appreciate that if you use appropriate stains the chromosomes and nucleolus are frequently visible under a light microscope. However the cell surface membrane is too small to see unless you use an electron microscope.

Question 2

At least 50% of less able candidates did not know that the feature of all prokaryotes is the presence of ribosomes. Candidates should be taught that prokaryotes divide by binary fission.

Question 3

It is encouraging to note that many candidates are able to use standard form when converting between mm and nm.

Question 4

Candidates should have used a microscope to observe sections of leaves and it is expected that they should know the relative positions of xylem, phloem, palisade and spongy mesophyll.

Question 6

Half of the less able candidates do not realise the difference in function between the rough and smooth endoplasmic reticulum.

Question 7

Whilst 66% of the candidates knew that hydrogen bonds are weak and disulfide bonds strong only 20% correctly knew that ionic bonds are also weak.

Question 8

Over 60% of less able candidates did not realise that the sub-units of proteins are non-identical amino acids.

Question 9

This question was very well answered by the more able candidates who realised that the products would be glycerol and an unsaturated fatty acid molecule.

Question 12

Over 70% of candidates worked out that the primary, secondary and tertiary orders of structure were involved. However, since there are two polypeptide chains, each including 3 amino acids from the active site, the quaternary structure must also be involved.

Question 13

Almost 65% of the candidates knew that in collagen, having covalent bonds between adjacent molecules and each three-stranded molecule being held together by hydrogen bonds, helps to give great tensile strength. However, only 17% realised that without having every third amino acid being small, the three-stranded molecule would not be close enough to form hydrogen bonds.

Question 15

Most candidates appreciated that the water potential of the solution in Y was less negative than that in W. However, since the cells at X (in solution Y) lost water, whilst the same cells in solution Y gained water, the cells at X in solution Y have a less negative water potential.

Question 18

It is possible for any cell in the body to contain mutated DNA. Cancer cells divide rapidly and as such would have a very short interphase.

Question 19

A significant number of candidates did not realise that a haploid cell cannot undergo a reduction division.

Question 21

This was only well answered by the most able candidates.

Question 22

Less able candidates find the events of DNA replication and transcription unclear. The correct answer is **C**.

Question 23

If no two amino acids adjacent to each other are the same, then you would only need 4 types of tRNA to translate the mRNA.

Question 25

The majority of the less able candidates are unable to clearly recognise the events in translocation through phloem.

Question 26

The majority of the less able candidates are unable to clearly distinguish the features of xylem and phloem.

Question 27

Only the most able candidates were able to work out that pressure potential is never negative and water potential will approach zero in the conditions described.

Question 28

A large number of less able candidates were unable to extract the data correctly from the graph.

Question 30

Whilst almost all the candidates realised that the surface area would decrease, less than half knew the volume would not change.

Question 31

This was poorly answered by 80% of the less able candidates. In order for the oxygen to reach the haemoglobin in a red blood cell it must pass through both cell surface membranes of an alveolus cell, both cell surface membranes of a capillary cell and one cell surface membrane of a red blood cell.

Question 32

Many candidates did not seem to understand what exocytotic vesicles are. Goblet cells use exocytotic vesicles to secrete mucus.

Question 36

Candidates must carefully read the question. Since avian flu is caused by a virus it cannot be treated by antibiotics. Killing all poultry does not prevent humans from spreading the disease.

Question 37

Over half of the less able candidates incorrectly selected answers that included water contaminated by sewage.

Question 39

It is encouraging to see that candidates are more able to differentiate between ecological terms. This was a description of a niche.

Question 40

It is expected that candidates should know that microorganisms are very small (in the range of micrometres). Therefore **B** and **D** could be eliminated. The most loss of leaf area occurred in the nets with a net size of 7 mm. Therefore anything that is small enough to enter through this net but not through a net of 0.5 mm would cause the breakdown of the discs, in this case this must be the earthworms and beetles.

BIOLOGY

Paper 9700/21
AS Structured Questions

General comments

The paper seems to have offered well-prepared candidates opportunities to achieve good marks over a wide variety of topics from many parts of the syllabus and many excellent and thorough responses were given by these candidates. A few outstanding candidates gained 50 marks or more. No questions were routinely omitted neither was the paper unfinished, except in very few cases, indicating that time was not an issue for candidates. There were a number of instances where it was clear that candidates had not used spare time to check that their response actually answered the question. Reading time is built into the construction of the paper and candidates who take time to re-read information, for example in the introductions and data for **Questions 2, 5** and **6**, are less likely to misinterpret the requirements of the question. Recall of factual information seemed to be relatively easy for the majority of candidates, although as always, candidates had difficulty applying knowledge and understanding to a new situation, such as that given in **Questions 5** and **6**.

Few problems with legibility were encountered, although spelling was quite frequently inaccurate. The grammatical constructions occasionally made it difficult for Examiners to be sure of the meaning intended but there were generally good standards in this respect. Some candidates may find it more helpful to write their ideas in short sentences, rather than attempt to string together a number of ideas in one long sentence. It was clear that in many cases candidates had made efforts to plan their answers and present their ideas in logical order. However, some candidates did not differentiate between description and explanation successfully and, at times, either marks were lost, or answers unnecessarily repeated information which was not relevant to the requirements of the question.

Question 3 (a)(iii) and **Question 6 (c)** and **(d)**, proved to be the most difficult to gain full marks, even for the most able candidates. As in previous sessions, some questions (**Questions 1** and **3** are good examples) required candidates to draw from various strands of the syllabus and Centres should be encouraged to refer regularly to learning outcomes and syllabus sections when teaching topics. **Question 4(b)**, required candidates to refer to a graph in order to compare rates of transpiration. Where grid lines are drawn for graphs, candidates are expected to be accurate in extracting information, including giving units. In previous sessions, this has not been tackled well by candidates and it was pleasing that in this session, Examiners noticed an improvement in this aspect. Performance on **Question 6** was very variable and many candidates who had performed very well up to this point, lost marks on the last two parts.

Comments on specific questions

Section A

Question 1

This question required candidates to consider subject matter in 3 different syllabus sections, Biological molecules, Cell membranes and transport, and Immunity. Most candidates were able to score at least half marks for this question and many gained 9 or more marks.

(a)(i)(ii) Although Fig. 1.1 was a familiar molecule to candidates, a significant proportion had very little idea of the details of the structure of an antibody molecule and almost every location on the diagram was suggested for the variable region and disulfide bonds. Many candidates only offered one location for the disulfide bonds and it was interesting that some of these did go on in part **(b)** to explain that these bonds held the *four* polypeptide chains together. Those that made efforts to apply general knowledge of protein structure were able to gain one or even two marks.

(iii) Many candidates answered this well enough to pick up at least 2 marks, mainly for the knowledge that the disulphide bond was a strong bond and important in tertiary / quaternary structure. The

role of the bond in maintaining shape was another popular marking point gained by many candidates. Stronger candidates had no problems in gaining maximum marks; a number showing a sound knowledge of the importance of the bonds in protein structure and related this well to antibodies. Only a handful noted that the disulphide bonds were between cysteine groups.

(b) This topic seems to have been well studied and understood by most candidates and there were some excellent responses covering the many different ways that antibodies provide protection. The comprehensive list of marking points allowed most candidates to gain at least 2 of the available 4 marks. In many cases there was a hint that candidates had the right ideas, but failed to use sufficiently correct terminology to express themselves. The idea that the constant region was able to fit receptor sites on phagocytes in order to facilitate phagocytosis was mentioned least. Weaker candidates gave vague answers such as 'antibodies kill pathogens' but did not qualify their response, while others confused antibodies with phagocytes or lymphocytes.

(c) Surprisingly few candidates scored all 3 available marks but almost all gained at least 1 mark, generally for mentioning facilitated diffusion or for describing active transport: for example, explaining that the carrier proteins allowed ions or polar molecules to pass through the membrane against the gradient. In this case, it was curious that many described but few actually named the process as 'active transport'. Many candidates also noted cell recognition or receptor sites and it was pleasing that a number correctly gave examples of molecules that could bind to the sites. Occasionally cell-cell adhesion was acknowledged. It was rare for Examiners to see 'enzymes' as a role of proteins in the membrane. A number did have a knowledge that proteins helped to stabilise the membrane, but they were not credited unless they recognised that the bonding occurred with the watery surroundings.

Question 2

This question differentiated well and rewarded stronger candidates with full marks. At the other extreme, poorer responses gained no more than 3 or 4 marks, generally picking up only 1 mark from each part-question. These candidates proceeded to write their answers without having fully digested *all* the information that was in the lengthy introduction that also contained data. In addition it was noted that many failed to use data from **Table 2.1** despite being asked in **(c)** to refer to the candidates' results.

(a) The majority of candidates gained both marks, but those who omitted to record that iodine was aqueous, dissolved in potassium iodide solution, usually got the correct colour change. A few candidates gave the wrong test solution and even fewer gave no colour change, only noting the test solution used. Centres could discuss with candidates the difference between the question asked and 'state the reagent the candidate would use to test for the presence of starch.'

(b) The graph was usually drawn well enough to earn the majority of candidates 2 marks, but a surprisingly large minority carelessly recorded the peak at some distance away from pH 6.0 and and / or the zero rate of hydrolysis within the pH range 3-8, which was not supported by the data in **Table 2.1**. Although Examiners were expecting candidates to use the data provided, it was also hoped that knowledge of the standard shape of the curve of rate of reaction against pH would fashion the overall shape of the curve sketched in part **(b)** and this was the case for many candidates. However, 'tent', 'dome' and asymmetrically shaped curves were also seen on more than one occasion.

(c) There were, occasionally, excellent responses given by knowledgeable candidates who clearly had a sound understanding of the molecular activity of enzymes. Answers here not only described the candidate's results and made reference to actual data, but also went on to give full explanations for the results. This contrasted with accounts where candidates contradicted themselves by referring to 'no starch present' as being a slow rate of hydrolysis or other instances where candidates had not noted the *key* to **Table 2.1** and had assumed that the ticks referred to pH values in which the reaction had occurred quickly. However, the majority of candidates did give good descriptions which earned them most of the available marks and could have gained maximum marks had they attempted an explanation of the results. Only a minority of candidates gave a time date quote from **Table 2.1** as part of their description and of those that realised that denaturation was occurring at the lowest and highest pH values, only a proportion went on to refer to the values provided.

Question 3

This was a question of 'two halves' for many candidates. Almost all candidates made good attempts at part **(b)** but part **(a)** was not always confidently answered by many and a large proportion of candidates who were scoring well with other questions lost marks by failing to recognise the correct stage of mitosis in **Fig. 3.1**.

(a) (i) Most candidates did not recognise this electron micrograph, giving 'telophase', without qualifying it as 'early', which Examiners would have accepted, or 'cytokinesis', as the stage. These candidates did not notice the defining feature that would link the micrograph to the correct stage, 'anaphase': the chromosomes, separate from each other, trailing behind the centromeres that had nearly reached the poles. Some of those that recognised the correct stage referred to the 'ends' of the cell rather than the 'poles' but still managed to gain 2 marks from some of the other available mark points. Those who thought that the stage was cytokinesis, did not recognise that this stage of the cell cycle is not part of mitosis, nuclear division, but is associated with cell division and (usually) overlaps and succeeds mitosis. 'Name the stage of mitosis shown' was clearly given as the question.

(ii) Most candidates knew that preparing samples for electron microscopes require that they are killed, which earned them 1 of the available 2 marks. Some did go on to explain that this meant that it would not be possible to view a process happening. Only occasionally was a reference made to any of the other available mark points. A surprising number of candidates thought that magnification and / or resolution was not as good as the light microscope.

(b) (i) This topic appears to have been well delivered by Centres and this part was generally very well answered by most candidates, with many candidates gaining full marks, often noting 5 or 6 correct points. A few were diverted into listing the general effects of smoking on the lungs and did not mention tumour development. Some candidates seemed to think that cigarettes contained oncogenes and many confused rapid mitosis with uncontrolled mitosis. The best answers showed an understanding that a mutation occurred within an epithelial cell and that this led to a loss of control of cell division. Other answers were very vague, for example, stating that a 'mutation occurred in the lungs'.

(ii) Usually both marks were gained here. Some candidates confused breathing with respiration and a number gave 'tiredness' which was not credited, although 'fatigue', which is far more akin to a disease symptom, was able to score. Quite a few of the symptoms overlap with those of chronic obstructive pulmonary disease and at times, especially for those who had described scenarios of bronchitis and emphysema for **(c)**, Examiners erred on the side of generosity.

Question 4

Overall, most candidates made a fairly good attempt at this question, picking up marks in all sections and showing a sound understanding of the subject matter. Those candidates who paid careful attention to detail when answering were rewarded with maximum, or at least very high, scores. However, it was disappointing that there were quite a few candidates who failed to gain both marks for **(a)**, which only required candidates to recall knowledge and give a straightforward explanation of the term transpiration.

(a) Many candidates omitted to state that it is water <u>vapour</u> which is lost from the plant, or else thought that water evaporated, rather than diffused, through stomata. Few knew the term 'aerial' for the upper parts of a plant, but this did not prevent a high proportion of candidates from gaining both marks with a simple explanation that transpiration is 'the loss of water vapour from the leaves of a plant'.

(b) Most candidates seemed to be able to interpret the graphical data but then were often unable to describe accurately the sequence of events which gave rise to them. There were only a few candidates who gave no units, which was pleasing, and most noticed the overall pattern of the curves, although a significant minority did not read the scales accurately. Not all candidates were aware that a request to 'compare' means that statements of similarities as well as differences are expected.

(c) Having made the link that species B was likely to be a xerophyte, it was not difficult for candidates to gain 1 or 2 marks for stating features of xerophytic leaves. The harder part was to give an explanation as to how the feature reduced the rate of transpiration and for this reason only the strongest candidates gained all 4 marks. The most popular features stated were thick, waxy

cuticle, hairs and sunken stomata. Quite a number of candidates omitted 'thick' for the cuticle and so did not qualify for a mark and most candidates thought the cuticle was there to reflect light but not that heat is also reflected and so would affect the rate of diffusion. Many candidates did not note that the cuticle is waterproof. The trapping of water vapour or increasing humidity immediately outside the stomata were mentioned but many candidates just repeated that the transpiration rate was thus reduced, which was given in the question, not that the diffusion gradient was lengthened or that it was then less steep. A multi-layered hypodermis or thick-walled epidermal cells was rarely mentioned.

Question 5

This question produced a wide range of marks, with some candidates finding it difficult to cope with a question that had strands coming from a number of different areas of the syllabus. This contrasted with some excellent responses from the stronger candidates who were able to apply their knowledge and understanding to the unfamiliar material in **(a)** to **(c)** and who went on to give fluent accounts of the problems of controlling the spread of HIV/AIDS.

(a) Some candidates omitted to complete any of the boxes in **Fig. 5.1**. 'Meiosis' was usually given correctly, as was 'mitosis' for the box for the asexual phase. However, quite a number of candidates gave 'meiosis' rather than 'mitosis' for the final box, possibly thinking that this was the second stage of meiosis. As there were only two marks for this part, many candidates ended up scoring only one mark, despite getting two out of three answers correct. Some candidates did not seem to notice or understand the chromosome numbers in the cells and a few wrote something other than meiosis or mitosis in the boxes.

(b) Although extremely accessible, **(b)** was not as obviously straightforward as questions in previous sessions asking for prokaryote / eukaryote comparisons. For those candidates who read the question carefully, **(b)** was not a problem and the presence of structures such as mitochondria, Golgi body and endoplasmic reticulum were given to gain the 2 available marks. However, other candidates lost a mark by giving 'true nucleus' as a cytoplasmic feature. Some candidates seem to have misread the question and gave features of prokaryotes.

(c) Questions about disease transmission invariably expect candidates to respond by noting how the disease causing organism is transmitted from a host as well as how it enters the body of an uninfected person. Many candidates seemed to know how TB is transmitted and were able to apply the principles to the transmission of the yeast spores. A number did not mention the need for an aerosol, moist air or droplets of mucus / saliva from coughing or sneezing, though many mentioned 'air' droplets. Some candidates omitted to mention that spores must be inhaled by the other person and did not get the second mark. A significant minority were fixed on a link with HIV / AIDS and gave a list of ways of transmitting the human immunodeficiency virus, hence incorrect answers referring to blood transfusions, lack of using condoms and sharing contaminated needles were also seen.

(d) The mark scheme allowed for the full and varied range of answers that candidates could have given and all mark points were seen. Many candidates gained full marks in **(d)**, recognising the problems facing governments and local health authorities in the fight against the spread of HIV/AIDS, including the difficulties of changing people's behaviour. Although most candidates gave an account worthy enough for them to gain 3 or 4 marks, Centres should continue to advice candidates to check the mark allocation for guidance as to the minimum number of points to consider in their response. Some responses only included two or three issues. In addition, candidates need to be reminded that vague answers such as 'people aren't well educated' or 'people having sex without protection' are not sufficiently explicit to be credited with a mark. There were also comments about difficulties of 'sensitising' people, but this is not the same as stating that there are difficulties educating them about the risks and methods of avoidance of HIV. There were a considerable number of candidates who confused polygamy with promiscuity.

Question 6

This question proved to be more challenging to many candidates and a large proportion of candidates gained 4 marks or fewer out of the available 9, with **(c)** frequently gaining no marks at all. More able candidates struggled to gain more than 6 or 7 marks.

(a) The meaning of the term 'ecosystem' is a learning outcome on the syllabus and some candidates had no problems giving the required response, although only a few considered all the various aspects of the term: self-sustaining, community, abiotic factors and the various interactions. However, a significant proportion of candidates just gained 1 mark as they had grasped only part of the concept. There are a number of learning outcomes in the syllabus that require candidates to be able to explain the meaning of specific terms and Centres should emphasise to candidates the need to be accurate when answering questions.

(b) Most candidates gave a correct calculation. Occasionally, the rounding up was not given to 0.1% as requested. A few candidates appeared to have entered their figures incorrectly into a calculator and then, unfortunately, not carried out a rough check to assess the numbers which appeared.

(c) Candidates seldom gained more than one mark for this section and most of those who did only mentioned that many parts of plants are not only inedible but also indigestible by many herbivores. Occasionally the larger contribution of producers to detritus was noticed. A few candidates calculated the corresponding efficiency of energy transfer and usually did so correctly.

(d) On the whole, there were mainly very weak responses given for **(d)**. It was rare for candidates to mention that decomposers break down the proteins in dead plants and animals and very few included details of this process in their response. Most thought that the important points revolved around replacing the nitrogen in the air, the process of denitrification, which is not carried out by decomposers. Similarly some candidates confused nitrifying bacteria with decomposers.

BIOLOGY

Paper 9700/22
AS Structured Questions

General comments

Marks were spread over a wide range, with all questions discriminating well, particularly **Questions 1- 4**. The majority of candidates attempted all question parts, indicating that these were accessible and the paper in general was well answered by most candidates. Those candidates who had not scored well lost marks by giving answers that were too general or did not use correct scientific terminology. Well-prepared candidates, who had also made good use of previous examination papers and mark schemes, were able to obtain relatively high marks for this paper, although there were few candidates who gained more than 50 marks. **Question 1(c)**, **Question 3(a)** and **Question 6(b)(ii)** and **(iii)**, proved to be the most difficult to gain full marks, even for the most able candidates.

As in previous sessions, some questions required candidates to draw from various strands of the syllabus and Centres should be encouraged to refer regularly to learning outcomes and syllabus sections when teaching topics. It was very pleasing that **Question 5**, which used material in an unfamiliar context, was well tackled by many candidates. **Question 4(a)(ii)**, required candidates to refer to a graph that required expertise in extracting information. In addition, there is evidence that many candidates do not understand the difference between the command terms 'describe' and 'explain'. The information in Fig. 4.1, as well as in Fig. 6.1, could be used by Centres as excellent practice for extraction and interpretation of data. Both require candidates to have a clear understanding of the subject matter involved and demand attention to detail. Performance was therefore patchy with **Questions 4** and **6**, often being very poorly answered, even by candidates scoring highly on the other questions.

Generally, candidates were less inclined than on previous sessions to extend their answers beyond the number of lines given, although a number of candidates who were not confident as to what was required for **Question 4(a)(i)** and **(b)** gave lengthy answers. Similarly, those candidates who thought incorrectly that they had to give a description of transcription and translation for **Question 5(b)**, used the blank space below to complete their answers, clearly having paid little attention to the mark allocation. There was no evidence that candidates ran out of time.

Comments on specific questions

Section A

Question 1

This question required candidates to consider subject matter in 3 different syllabus sections, Cell Structure, Cell Membranes and Transport and Immunity. Most candidates were able to score over half marks for this question and many gained 9 or more marks. However, only a handful gained maximum marks, with the fourth mark on **(c)** proving elusive for most. Some candidates failed to notice that the introduction to **(a)**, "*With reference to Fig. 1."* referred to both **(i)** and **(ii)**.

(a) (i) Almost all candidates were able to gain at least 1 mark for this part question. Where only 1 mark was gained, candidates generally had concentrated only on describing one of the two, calcium ions *or* the phospholipid bilayer. There were many responses that incorrectly described calcium ions as polar or large, but were still able to gain full marks by going on to explain that calcium ions were charged and that they were unable to get through the hydrophobic core (caused by the fatty acid tails) of the phospholipid bilayer. A few candidates had not read the question and described the role of the membrane protein or incorrectly described how calcium ions could pass through the membrane.

(ii) Many candidates answered this well, picking up all 3 marks. However, some candidates did not appear to refer back to Fig. 1.1 and note that this was an example of active transport; hence there were a number who named and described facilitated diffusion. These candidates were given credit for correct knowledge of the type of membrane protein involved, binding and conformational change, so were able to potentially gain 2 out of the 3 marks. It was more difficult for Examiners to award marks where candidates confused details of active transport and facilitated diffusion.

(b) The best answers were knowledgeable in the role of membrane receptors in binding to bacterial antigens and also gave clear descriptions of how the cell surface membrane changed to envelop a bacterium to produce a phagocytic vacuole. Some able candidates lost a mark by failing to note the fusion of the membrane to produce the vacuole, or forgot to state that the vacuole had formed. Weaker candidates gained marks for a description of the membrane enveloping the bacterium. Many realised that the bacterium binds with the cell surface membrane but did not mention receptors or did not know the difference between a receptor and an antigen, referring incorrectly to the antigen on the cell surface membrane. For some, there was confusion between phagocytes and lymphocytes. Some responses did not stop after their description of phagocytosis and continued to describe the mark points allocated to **(c)** as well as exocytosis.

(c) The majority of candidates were able to score 3 out of the available 4 marks, correctly describing the fusion of lysosomes to the phagocytic vacuole and the release of hydrolytic enzymes. However, it was rare for candidates to describe the reactions catalysed by the enzymes and where responses had ventured into this area, descriptions were too general, e.g. 'breaks down the bacterial cell wall' and 'digests the bacterium'. Common errors were descriptions of lysosomes fusing with the actual bacterium and lysosomes being described as hydrolytic or digestive enzymes, rather than *containing* them. As in **(b)** there were many who had described exocytosis, which was not required and will have lost valuable time.

Question 2

It was pleasing that the majority of candidates demonstrated an understanding of the investigation performed by the candidate and many went on to gain good marks. It was helpful that, in part **(c)**, 'describe' and 'explain' were not separated into **(i)** and **(ii)**. This meant that those candidates who find it difficult to distinguish between the two terms were still able to gain maximum marks if they were sufficiently thorough in their answer. In **(a)**, some candidates who incorrectly thought that the increased temperature of 85°C increased the rate of reaction carried this idea over into their answers to **(c)**.

(a) Many responses incorrectly described the increase in temperature as leading to an increase in the rate of reaction and enzyme-substrate complex formation, and hence scored no marks. Of those candidates who correctly understood that the enzyme would be denatured at high temperatures, only a proportion went on to explain that this would stop the reaction and even fewer qualified this to explain that each tube will have then been allowed the same time for the enzyme to act. Some candidates contradicted themselves by describing an increase in rate of reaction with denatured enzyme. Many responses considered the high temperature requirement for the Benedict's test, although reference to the presence of reducing sugars was only seen occasionally. Stronger candidates covered all aspects.

(b) Although most candidates were able to gain maximum marks, not all candidates noted the y axis labelled as *'rate of hydrolysis'* and drew curves with a y axis equivalent to *'time'*, simply extracting the data shown in Table 2.1. These candidates were still able to gain 1 mark if the curve levelled off after 50 g dm^{-3}. Although not necessary for this question, a significant minority of candidates made the effort to calculate rates to help in their construction of a curve. It was notable that weaker candidates who did not recall the general shape of a substrate concentration / rate curve, had not thought to use the data in Table 2.1 to guide their answer. In these instances straight lines, sigmoidal curves and curves going up to infinity were seen.

(c) There were some excellent responses here, with many candidates clearly understanding the biology and being able to express their answers well to gain maximum marks. This contrasted to some accounts that were confused and poorly expressed, with a number of contradictions that made it difficult for Examiners to award marks. Good responses gave correct reference to molecular details regarding availability of active sites at different substrate concentrations. Better answers also demonstrated a good knowledge of substrate and then enzyme concentration as limiting factors, in addition to linking these to data extracted from Table 2.1. However, many failed to make it clear in their answers that they understood the idea of the concentration of sucrose

being a limiting factor at low substrate concentrations. Very few discussed the action of sucrase in breaking glycosidic bonds or stating the products of hydrolysis. Only those candidates who made correct reference to the candidate's results were able to gain all five marks. Some candidates extracted results from Table 2.1 but did not recognise 50 g dm^{-3} as being the point at which rate becomes constant. Many thought that the rate decreased or that the reaction stopped when the active sites of the enzyme were occupied.

Question 3

Although there were many high-scoring answers to this question overall, it was very rare for a candidate to gain both marks for **(a)**. In **(c)(i)**, where candidates incorrectly identified the stage of cell division as 'anaphase', marks were also lost in **(ii)**.

(a) This question was particularly challenging for candidates, with many just repeating the question. Where 1 mark was gained, it was generally for stating the need to keep the chromosome number constant. Only some candidates realised that genetically dissimilar cells would be subject to the responses of the immune system. Responses that stated that cells need to form tissues with a particular function were not relevant to the question as all genetically identical cells have the information to potentially form any tissue type; it is the selection of genes for expression that are important in these cases.

(b) This was generally well answered. Many candidates gained the carcinogen mark, either explicitly or implicitly by mentioning tar and went on to score the second mark by mentioning X-rays or UV. Answers that did not gain credit were general references to 'smoking' rather than a named carcinogen in tobacco smoke and general references to radiation or exposure to the sun.

(c) (i) Whether candidates correctly stated cytokinesis was often Centre-specific. Approximately 50% of responses named the mitotic stage (nuclear division) 'telophase' rather than state the stage of *cell* division. However, credit was then given in **(ii)** for those candidates who used the term 'cytokinesis' in the correct context. Examiners marked the first stage that appeared on the answer line where candidates wrote more than one stage. 'Anaphase' was also frequently seen as an incorrect response.

(ii) There were many clear descriptions of what was happening to the cell in Fig. 3.1, with better responses using terms that reflected an understanding of the events, for example, 'nuclear envelope forming' rather than 'appearing' and 'spindle breaks down' rather than 'disappears'. There were ample mark points on the mark scheme to enable well prepared candidates to gain all 3 available marks. Weaker candidates incorrectly described the chromosomes condensing or re-coiling and some reverted back to **(a)** and gave some detail about the genetically identical nature of the cells. Some also referred to the specifics of the cancer cells. Unfortunately, accurate descriptions of anaphase were not relevant for this question and lost a number of candidates all 3 marks.

(iii) The majority of responses gave sufficiently good accounts of tumour development to gain both available marks. Many candidates demonstrated an excellent understanding and knowledge of the subject matter and a small minority gave additional details such as 'loss of function' or 'lack of differentiation'. Details of carcinogens, mutations or metastasis were not required as the question had only asked about tumour formation. Where candidates only gained 1 mark, this was for an understanding of *uncontrolled* mitosis. 'Rapid mitosis' or 'continuous growth' without the idea of uncontrolled mitosis did not score. For most, the second mark gained was for a correct description of the formation of a mass of (abnormal) cells.

Question 4

Those candidates who took the time and effort to thoroughly digest the information given in the text and in Fig. 4.1, and who then went on to read the questions carefully, were often rewarded with maximum marks. It was particularly noticeable that in **(a)(ii)** many candidates attempted to explain, rather than describe, the changes to the rates shown in Fig. 4.1.

(a) (i) This posed no problems for well rehearsed candidates and a generous number of separate marking points allowed good marks to be obtained by many candidates. Candidates scored a mark for mentioning that water *evaporates*, but the site of evaporation was not always clearly given as the "*wall of a spongy mesophyll cell*". Answers that only talked about *mesophyll cells* did not score. Evaporation had to be from inside the leaf and not used synonymously for diffusion. General or factually incorrect statements such as 'water moves down the water potential gradient to the outside' or 'water evaporates through the stomata' or 'water moves by osmosis to the airspaces' were given by weaker candidates. However, a mark was available for gradients expressed correctly in terms of water potential and it was pleasing to see that few candidates still use the term 'water concentration'. Although the question asked about water loss from the leaves, some candidates began their answer earlier in the plant by talking about roots and osmosis, routes across the cortex and cohesion-tension. Responses that considered the exit of water from the xylem and continued to describe the apoplastic and symplastic pathways frequently did not progress much further and failed to give the necessary detail to start to earn marks.

(ii) The biggest contributory factor between high and low scoring answers was probably whether a candidate noted that the question asked for a description. The question also asked candidates to refer to Fig. 4.1, which was a 'gridded' graph to enable data to be extracted exactly and correctly. The best answers confined themselves to describing the graphs and quoting data from both scales to illustrate their descriptions. Candidates should note that when reading off numerical data from graphs it pays to be as accurate as possible. A surprising number of candidates found difficulty in accurately quoting times from the horizontal time axis. It was disappointing how many candidates made mistakes, were imprecise, or failed to give *comparative* data to show *changes* in both the rate of water uptake and the rate of water loss. For example, the increase in rate of mass loss which began at 0400 was often quoted as beginning at 0600 and the maximum rate of mass loss was quoted as 4.5 rather than 4.4 g h^{-1}. Similarly for rate of water uptake, the peak time was given as 1800 rather than at 1900. Some candidates chose to describe separately the two different rates, while others made comparative statements between the two. The mark scheme accommodated either approach. Lengthy accounts *explaining* water loss and uptake, in relation to light and dark periods, photosynthesis and stomatal opening, failed to score, a costly mistake for some candidates.

(b) The question asked candidates to consider the mechanism of water transport *in* the xylem of the leafy twig while *in the potometer*. The most popular points to gain the 3 marks were in describing the transpiration pull, the cohesive nature of water *molecules* and the adhesion of water molecules to the walls of the xylem. Only a minority of candidates named the cohesion-tension theory and fewer gave explanations that included knowledge of the importance of hydrogen bonds. Some candidates knew the role of the (hydrophilic) cellulose lining in the adhesion of water molecules to the xylem walls. Some candidates used phrases like "*with the help of cohesion and adhesion"* and if this was all they said, then no marks were given. Many candidates wasted time by giving explanations of water potential gradients and differences in hydrostatic pressure. In addition, a description of movement across the root cortex by the symplastic and apoplastic pathways or the entire process of transpiration was not required.

Question 5

This was well attempted by the majority of candidates, who were able to apply their knowledge of cell structure and the function of cell organelles to a new situation.

(a) (i) This scored well for almost all candidates, with only some candidates mistaking the vacuole, label **L**, for the nucleus and other candidates spelling 'nucleolus' so incorrectly that Examiners could not be sure that 'nucleus' was intended. **L** was also occasionally termed cell membrane, cell sap or even plasmid. **H** was occasionally identified as the nucleus, and **J** as SER. A minority of responses gave 'capsule' or cell membrane for label **K**, the cell wall. Candidates were not intended to know the chemical nature of the cell wall of *Candida albicans* and for this reason 'cellulose cell wall' was credited with the mark. 'Murein' was rejected as this is solely a feature associated with prokaryotes.

(ii) This was very well answered and all the mark points were seen by Examiners. The most popular responses named mitochondria and ER as organelles not present in prokaryotes. The presence of mesosomes was allowed on this occasion, even though these are now known to be artefacts caused by chemical fixation for electron microscopy. Centres should be discouraged from including mesosomes as a feature of prokaryotes. Some candidates thought that prokaryotic cells had no ribosomes or no cell wall. Compared to previous sessions, there were fewer candidates who confused prokaryotic and eukaryotic features.

(b) There were some excellent answers from better candidates, who gave concise, sequential accounts of the production of the TMP1 transport protein, including the role of all the organelles involved in the production. Other responses may have realised the involvement of the nucleus, ribosomes and Golgi body, but failed to explain the formation of the Golgi vesicle and subsequent fusion with the cell surface membrane in order to position the protein within the membrane. Many candidates failed to understand what was required of them and gave detailed descriptions of transcription and translation, hence only scoring 2 of the 4 available marks. A significant minority wrote about the function of the TMP1. Common misconceptions included ribosomes synthesising amino acids and genes which left the nucleus. Many candidates began by referring to the role of the nucleolus in ribosome production but this point was not on the mark scheme as the nucleolus has no *direct* role in the production of proteins such as TMP1.

Question 6

This question produced a wide range of scores, with **(b)(iii)** frequently gaining no marks at all.

(a) The meaning of the term 'community' is a learning outcome on the syllabus. Although some candidates gave very clear and precise definitions of the term, it was surprising that a significant proportion of candidates were not able to answer the question sufficiently to gain the 2 marks available. Some gave confused definitions of 'ecosystem' and referred to interactions between the organisms themselves and with the environment, while others made reference to all the organisms being able to interbreed, or only animals being the members of the community. For those on the right lines, many failed to note that a community included *all* the organisms occurring in the *same* place and so were not able to gain the marks. There are a number of learning outcomes in the syllabus that require candidates to be able to explain the meaning of specific terms and Centres should emphasise to candidates the need to be accurate when answering questions.

(b) (i) The majority of candidates chose correct values for the calculation. In addition, more candidates than in previous sessions noted what was required for the final answer and gave the answer to the nearest decimal point. Of those responses failing to gain the maximum marks, two common errors were not to express the answer to the nearest 0.1%, giving the answer as 4.47 or 4.48%, or inverting the relevant energy values and dividing 65 800 by 2946 and giving the answer as 22.3%.

(ii) The majority of candidates expressed, in various ways, that the energy available from the primary consumers was too small or insufficient to support another trophic level, but only a few qualified this with a calculation of 2 kJ^{-2} (8 + 3 kJ^{-2} lost to respiration and decomposers from an initial input of 13 kJ^{-2}, hence 13-11 kJ^{-2}). Some responses listed the various ways in which energy was lost, but this was not required. Some candidates argued that any that did survive would die of starvation or have to eat all the secondary consumers and that they too would be wiped out.

(iii) This proved to be a very challenging final question and the most difficult part question on the whole paper for most candidates, possibly as they may have had less time to think carefully about the question. Consequently, it was evident that few candidates understood what was required of them in this 'suggest' question and gave incorrect accounts of stages of the nitrogen cycle rather than concentrating on decomposition. Many candidates stated that nitrogen is a source of energy. The majority thought that the energy flow to the decomposers was solely from organisms involved in the nitrogen cycle. Their responses in the main related to the conversion of ammonium ions in the animal waste to nitrite and then nitrate and finally nitrogen as providing the energy flow to the decomposers. They often quoted *Nitrosomonas, Nitrobacter,* and even *Rhizobium* as being responsible in providing the energy. Others thought that the nitrogen in the animal wastes was taken up by the roots of plants or the leaf litter itself to provide for plant growth and hence more plant material to decompose. The Examiners were expecting the candidates to indicate that dead leaves and twigs provided little protein, or nitrogen sources in general, and were thus difficult to decompose, especially the cellulose and lignin. The addition of proteins, amino acids, urea from animal wastes provided nitrogen containing material for growth of the decomposers and the

production of enzymes necessary to break down the leaf litter. This in turn led to more decomposers being available and faster decomposition and as a result increased the energy flow to the decomposers. Only a very few candidates mentioned that the animal waste provided nitrogen sources for the growth of decomposers and even fewer appeared to appreciate that leaf litter contained substances, such as cellulose and lignin, which are difficult to hydrolyse. At most, some candidates gained 1 mark, generally for knowing that some bacteria are decomposers. There were only rare occasions where a candidate gained 2 or 3 marks.

BIOLOGY

Paper 9700/31
Advanced Practical Skills 1

General comments

The majority of Centres returned the completed Supervisor's report, but in a very few cases the report was not enclosed with the candidate papers. Centres are reminded how important it is that the Examiner receives the report with each packet of scripts, so that candidates are not penalised for any problems encountered with the practical or by individual candidates.

In a few cases it appeared that the confidential instructions had not been seen before the day of the examination. For the candidates, the materials and apparatus required are vital to the success of the examination and thus it is important that entries are made early so that the confidential instructions are received in good time.

Although it is essential that these instructions remain confidential and are not left anywhere where a candidate may see them, they should be available for use prior to the examination. It is possible that for biology practicals the Centre may be required to germinate seeds or try out reagents.

However, without prior knowledge of the requirements a Centre will be penalising candidates because with many biology experiments checking for example that the yeast is active is essential. Centres are reminded that extra reagents and solutions should be available for any candidate who requests them. It is important for the confidentiality of the examination that these reagents and solutions are only labelled as in the confidential instructions and thus the examination paper.

The question papers must not be opened prior to the start of the examination; any checks which are required prior to the examination will be included in the confidential instructions. Therefore it is important that the Centre does not make changes, either to the quantities or apparatus, without prior consultation with CIE as this may lead to changes which make it impossible for the candidates to fulfil the requirements for the skills being assessed.

Any materials supplied by Cambridge will be listed in the confidential instructions and if this includes a prepared microscope slide the Centre should arrange for the slides to be checked for their condition and that it is the correct slide. The material is confidential and should not be viewed prior to the examination. Slides are sent on the basis of one slide for two candidates, with a few spares, as the syllabus states that the number of microscopes expected is one for every pair of candidates. To enable each candidate to complete the activity needing the microscope, Centres should make sure that each candidate has sole use of the microscope for 55 minutes. The organisation within each Centre varies depending on the number of candidates and the facilities available.

Whilst Cambridge will continue to send out eyepiece graticules until 2012 it is expected that Centres should supply microscopes fitted with an eyepiece graticule. To enable candidates to draw the correct proportions they should be familiar with using the eyepiece graticules when drawing specimens from slides.

It was very pleasing that many candidates demonstrated that they had a good understanding of the skills required. There was good discrimination between the weaker and more able candidates, some of whom were able to score over 30.

For **Question 1** it was expected that candidates should carry out the instructions. Where candidates were familiar with following instructions and the correct measurement of the time taken for the first colour change was recorded candidates gained full marks. However a few candidates did not follow the instructions and recorded the colour change or multiple times for different colour changes. This meant that candidates were not able to use the difficulty of observing the first colour change as a significant error. Candidates should be told that as stated at the beginning of the question paper that all they are expected to do is to follow the instructions and record what they see happening. Thus Centres should not try to 'make the experiment work'

as this will make it more difficult for their candidates to select a significant error and in some examinations provide modifications.

For obvious reasons of the variability in world situations, data analysis or graph questions using the results of the candidate's own experiment are not set and the skills are assessed on common data so no candidate is disadvantaged by their own lack of results.

The syllabus shows that this component has a microscope activity and it gives the required specification for the microscope lenses. The examination questions are based on the use of an eyepiece lens of x10 with the appropriate x10 or x40, if higher power lenses are provided this may make it more difficult for the candidate to view the required section or cells which they need to draw without having to move the slide.

Candidates need to be familiar with using a microscope at low x10 and high x40; if additional lenses are present then they should be removed for the examination.

It is not acceptable for candidates to be given help to use the microscope as the use of the microscope is one of the skills being assessed. However if a microscope is found to be faulty this should be replaced or extra time allocated for the candidate to complete the activity on another microscope.

Centres are reminded that this paper is skills based and that candidates should be made aware of the possible skills that will be assessed. These skills are clearly explained in the syllabus, for example graph plotting. It was pleasing that many candidates were able to demonstrate that they have developed the skills as part of their course and were able to adapt their skills to unknown investigations and use unfamiliar material.

There was some evidence that candidates were failing to gain marks because they answered questions as if they were from a previous paper. For example, the questions which ask for the errors in an investigation will expect the candidate to select the most significant errors for that specific investigation. Those candidates who have the opportunity to develop these skills as part of their course are more able to adapt to the requirements in the practical examination and gain more marks.

Comments on specific questions

Question 1

(a) (i) It was pleasing that many candidates organised the table clearly to show the samples used and the time taken for the first colour change with seconds as the unit.

The most common mistakes were

- lack of a heading which described what was being recorded for example lack of suitable units. In this case the most suitable units were seconds.
- using incorrect or unclear recording of time. Some candidates record the reading from the stopwatch without showing the units and then converting to seconds for ease of comparison between the samples.
- failing to record in whole seconds and not to thousandths of a second.
- some candidates obtained results which did not fit the expected trend. Candidates should have been aware, from the information provided, of the expected trend for the concentrations given in the information and repeated any reading which did not appear to fit this trend. The order of times should have been W as the quickest then X, then Y, with Z the slowest.

(ii) Many candidates gained one mark for the correct units. However, candidates must be careful in copying the exact unit from the information provided.

The estimate depended on the value of **P** so if a candidate did not record a time for **P** then this mark could not be awarded.

Candidates should not give a value between two known values. The best answer would be that **P** is between this value and that value.

If the time for **P** was outside the times for **W** or **Z** then the estimate should have been greater than 5.00 or less than 0.25 with the correct units.

(b) A pleasing number of candidates gained the mark for +/- half the value for the volume of their smallest division and the correct units cm^3 or ml. Some candidates calculated the percentage error but failed to include the +/- and, since only certain volumes were measured out, then the percentage error had to be calculated using one the volumes used in the method.

(c) (i) Candidates need to consider carefully the most significant error in the procedure used and this was the identification of the first colour change or that **P** was measured between two concentrations or there were not enough known concentrations to be able to estimate **P** correctly. Candidates should not try to correct the error as this would be an improvement not the error.

(ii) The candidates who considered the procedure carefully were able to suggest that more known concentrations were needed and could give three additional concentrations. The use of a white background to help observe the first colour change would also enable the timing to be more accurate. The use of repeat measurements and the calculation of the mean would also have given marks. Some candidates tried to change the investigation by using an alternative method of measurement but the question required improvements to this procedure.

(d) Most candidates were able to suggest a suitable reason why the concentration of the sugar in the phloem is not always the same. Examples of suitable suggestions were

- the time of day or the season the sample was taken
- a different plant
- different environmental conditions

Any clear suggestion was accepted. However, some candidates confused the phloem with xylem or made vague statements about the absorption of sugars.

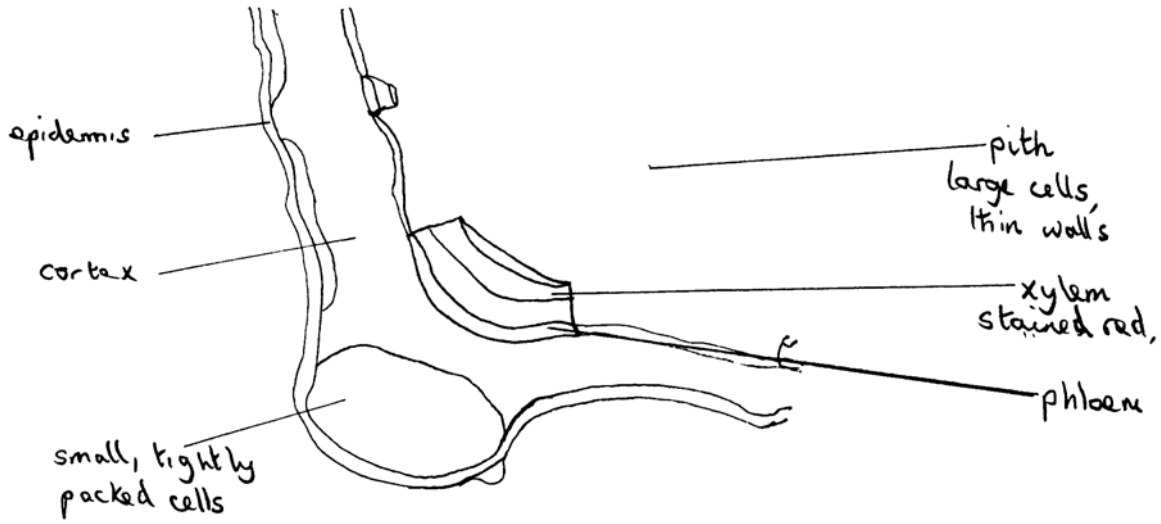
Question 2

(a) It was encouraging that the majority of candidates used clear, sharp unbroken lines to carefully draw the plan diagram with a suitable size, which should fill most of the space provided. Those candidates who used blunt pencils for the drawing lost marks.

The majority of candidates drew the correct quarter and those candidates who took the time to draw the shape of the corner, the region of cells in the corner and the shape and number of vascular bundles gained the marks.

As the drawing was from a photomicrograph it was expected that candidates would observe and draw carefully

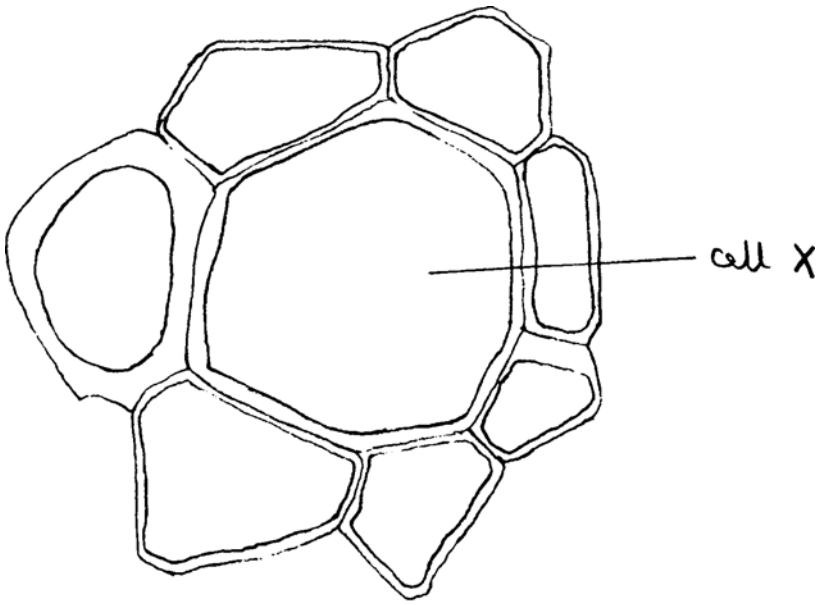
- the different regions of the tissues, even those within the vascular bundle
- the proportions of the layers
- label the tissues
- add two annotations for two different tissues



It was disappointing that few candidates understood that the annotations should have been of visible features such as the colours of the different regions, or the sizes or shapes of different cells making up the regions.

(b) It was encouraging that many candidates were able to gain five or more marks. As the photomicrograph was supplied it was expected that candidates would take the time to carefully draw the shapes and sizes of the cells.

Candidates should be encouraged to use double lines for the cells walls as shown below as this enables the thickness of the cell walls to be shown. It was disappointing that some candidates did not follow the instruction to label cell **X**.



Question 3

(a) (i) The syllabus requires that candidates should have studied cells using the light microscope. Those candidates who were familiar with making slides of material were able to present their observations clearly headed for each of the three slides and include descriptions of the yeast cells stained with the methylene blue. This required the careful use of high power and it appeared that some candidates only viewed the slides on low power. This limited their ability to gain the marks and many stated the observation only in terms of the colour of the methylene blue. Those candidates who drew their observations should make sure that labels are included to record their observations for example yeast cells stained blue or yeast cells clear or not stained.

(ii) This depended on the candidates results but those cells which were blue were dead and those which were not stained were alive.

(b) (i) The marks were not for the correct answer but for showing all the steps in the calculation. It was pleasing that most candidates gained both marks for showing the addition of the correct values divided by three and then by three again or alternatively by 9. A few candidates incorrectly read the wrong values from the table but were able to gain one mark for dividing these by a total of 9.

(ii) The graph should have been drawn with the concentration on the x axis. Some candidates did not gain the first mark because they did not include the units for both axes or placed the concentration on the y axis. However even these candidates could have gained the remaining marks if the scale used for both the x and y axes used more than half the grid, the points were plotted exactly and the points connected with straight lines or a smooth curve through all of the points. Some candidates were not careful in placing their cross or dot in a circle exactly at the correct point. Crosses or dots which become too large will not be given credit and there is some concern that crosses which are too small are lost when the line is drawn. If the Examiner cannot clearly see where the point is plotted then credit cannot be awarded. As a guide the length of each of the four arms of a cross should be no longer than 1 mm from the intersection. Each of the two intersecting lines should be

no more than 2 mm long. A dot should not be more than 1 mm across. The line used to connect the points should be thinner than 1 mm the use of a sharp pencil means that this should not be a problem and full marks for the graph would be expected.

(iii) Most candidates were able to describe the trend as an increase in the number of bubbles per minute up to a concentration of 1.5% followed by a decrease in the number of bubbles at higher concentrations. A few candidates did not include the units so failed to gain the marks. Those candidates who tried to explain the activity in terms of enzyme action were not answering the question which required a description of the trend.

(iv) This required the correct reading from the candidate's graph with the complete units of bubbles min^{-1}.

(v) Some candidates gave excellent answers in terms of the effect of the salt as a co-factor on the enzymes in the yeast increasing the release of the bubbles up to 1.5%.

At higher concentrations some candidates also explained that the salt would be either acting to inhibit the enzymes or that it caused water to be removed from the cells so that the activity decreased.

BIOLOGY

Paper 9700/32
Advanced Practical Skills 2

General comments:

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However without prior knowledge of the requirements a Centre will be penalising candidates because with many biology experiments checking for example that the yeast is active is essential. Centres are reminded that extra reagents and solutions should be available for any candidate who requests them. It is important for the confidentiality of the examination that these reagents and solutions are only labelled as in the confidential instructions and thus the examination paper.

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It was very pleasing that many candidates demonstrated that they had a good understanding of the skills required. There was good discrimination between the weaker and more able candidates, some of whom were able to score over 30.

For **Question 1** it was expected that candidates should use their knowledge of food tests to carry out the instructions. However a few candidates did not know the methods for the food tests and so were unable to complete the activity correctly.

For obvious reasons of the variability in world situations data analysis or graph questions using the results of the candidate's own experiment are not set and the skills are assessed on common data so no candidate is disadvantaged by their own lack of results.

The syllabus shows that this component has a microscope activity and it gives the required specification for the microscope lenses. The examination questions are based on the use of an eyepiece lens of x10 with the appropriate x10 or x40, if higher power lenses are provided this may make it more difficult for the candidate to view the required section or cells which they need to draw without having to move the slide.

Candidates need to be familiar with using a microscope at low x10 and high x40; if additional lenses are present then they should be removed for the examination.

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Centres are reminded that this paper is skills based and that candidates should be made aware of the possible skills that will be assessed. These skills are clearly explained in the syllabus, for example graph plotting. It was pleasing that many candidates were able to demonstrate that they have developed the skills as part of their course and were able to adapt their skills to unknown investigations and use unfamiliar material.

There was some evidence that candidates were failing to gain marks because they answered questions as if they were from a previous paper. For example, the questions which ask for the errors in an investigation will expect the candidate to select the most significant errors for that specific investigation. Those candidates who have the opportunity to develop these skills as part of their course are more able to adapt to the requirements in the practical examination and gain more marks.

Question 1

(a) (i) This was well answered by many candidates who had read and used the information provided to explain that in the mouth and small intestine the starch concentration would decrease and the glucose concentration increase. In the stomach the concentration of both starch and glucose would remain unchanged from that produced in the mouth. Some candidates rewrote the information provided as hydrolysis of starch to glucose and so failed to suggest what happened to the concentrations of both starch and glucose.

(ii) It was pleasing that many candidates organised the table clearly to show the tests used, the quantities of the reagents and samples and the results observed. The most common mistakes were

- lack of a heading which described what was being recorded, for example colour or observations
- not stating or stating a volume of Benedict's solution less than the volume of the sample.
- not stating or stating an unsuitable temperature for the heating of the Benedict's solution with the sample, which should have been equal to or more than 80°C or boiling,
- not stating or stating an unsuitable time to be kept the same, for example for the quantities used a result would be obtained in any time less than 10 minutes.
- in order to confirm the results all the samples should have been tested for starch and glucose.

(iii) Many candidates gained full marks for identifying correctly **S2** as the starch being eaten, either **S1** and/or **S3** as the mouth and stomach, as the solutions were identical, the results should have been the same and **S4** as the small intestine.

(iv) A pleasing number of candidates gained full marks for explaining that **S2** was the starch about to be eaten because there had been no hydrolysis or that there was no glucose or only starch present. Fewer candidates were able to explain the different degrees of hydrolysis between the mouth and small intestine or that there was no hydrolysis taking place in the stomach. The main difficulty for some candidates was that they described the results rather than explaining them and it is important that candidates understand what is required. There is a glossary of terms in the syllabus which candidates would find useful.

(b) Those candidates who understood that quantitative meant obtaining an actual value for the quantity of glucose were able to explain that a range of at least three known concentrations of glucose would be needed. After testing with Benedict's a measurement of the quantity of glucose would be obtained by either using a colorimeter or measuring the mass of the precipitate. The results could be used to compare to the unknown samples.

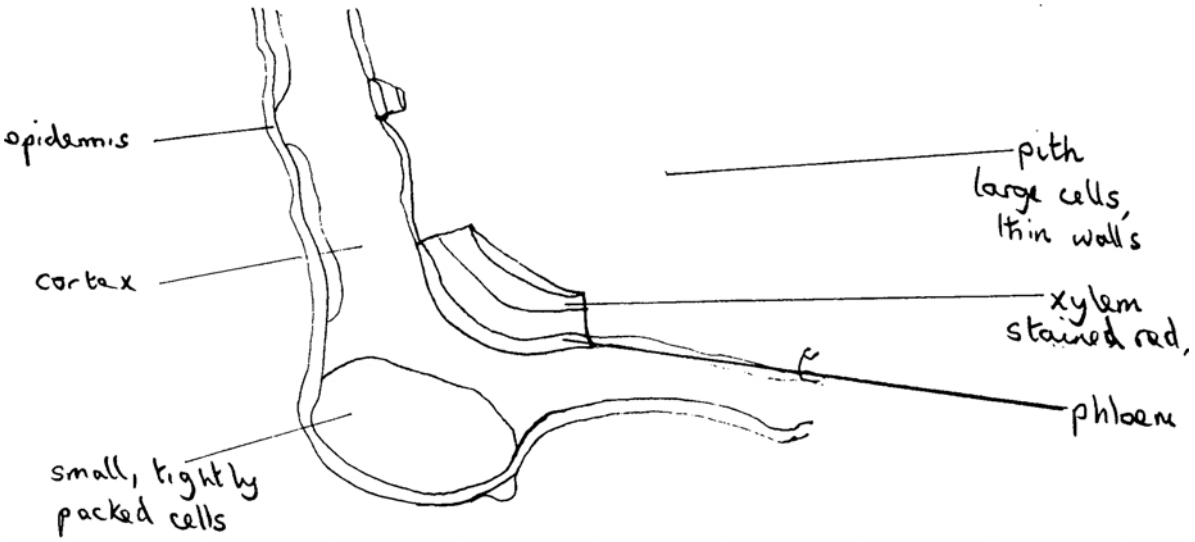
(c) (i) The graph should have been drawn with the concentration of starch on the x axis. Some candidates did not gain the first mark because they did not include the units for both axes or placed the concentration on the y axis. However, even these candidates could have gained the remaining marks if the scale used for both the x and y axes used more than half the grid, the points were plotted exactly and the straight line drawn through three of the points. Some candidates are not careful in placing their cross or dot in a circle exactly at the correct point. Crosses or dots which are too large will not be given credit and there is some concern that crosses which are too small are lost when the line is drawn. If the Examiner cannot clearly see where the point is plotted then credit cannot be awarded. As a guide the length of each of the four arms of a cross should be no longer than 1 mm from the intersection. Each of the two intersecting lines should be no more than 2 mm long. A dot should not be more than 1 mm across. The line used to connect the points should be thinner than 1 mm. The use of a sharp pencil means that this should not be a problem and full marks for the graph would be expected.

(ii) Many candidates correctly calculated the rate of hydrolysis by dividing the concentration by the time. If candidates are in any doubt then the units could have been used to help as g dm^{-3} per second means that g dm^{-3} is divided by seconds.

Candidates need to be given opportunities to understand the mathematical requirements given in the syllabus.

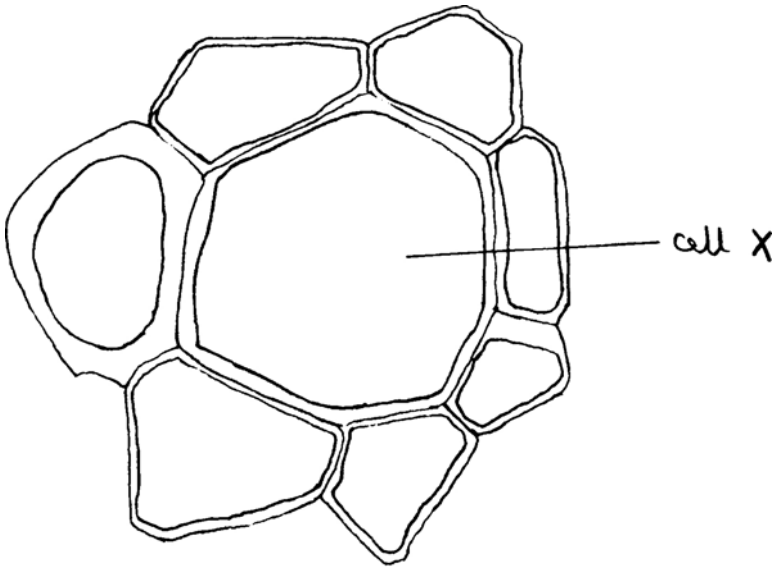
Question 2

(a) It was encouraging that the majority of candidates used clear, sharp unbroken lines to carefully draw the plan diagram with a suitable size, which should fill most of the space provided. Those candidates who used blunt pencils for the drawing lost marks. Those candidates who took time to draw the inner folds in proportion and accurately, with the clear layer lining the lumen, gained the marks. An example of a plan diagram which would have gained full marks is shown below.



It was disappointing that some candidates did not draw a plan diagram of the photomicrograph given and added labels which were not required.

(b) (i) Candidates found this drawing more challenging. Those candidates who had seen different types of stomata with their guard cells were able to identify correctly two guard cells and draw the complete cells surrounding them, as shown in the example of a drawing below. Candidates should take care to follow all the instructions as many candidates did not show on the figure the cells they had drawn.



(ii) The actual length of one of the guard cells should have been shown to be calculated by measuring the length in mm or cm and then converting this to micrometres by showing x 1000 or x10 000 respectively. As the magnification of the photomicrograph was x 400 the value needed to be shown clearly divided by 400 or as the value/400.

Question 3

(a) (i) The syllabus requires that candidates should have studied cells using the light microscope. Those candidates who were familiar with making slides of material were able to present their observations clearly headed for each of the four slides and include descriptions of the cells they had found. In the suspension of leaf cells guard cells, palisade cells, spongy mesophyll cells and xylem vessels may have been observed. Many candidates confused stomata with guard cells.

In the potato slides the cells should have been visible even without adding iodine. However, adding the iodine to both samples showed up starch granules inside the potato cells and in some cases inside the guard cells of the leaf suspension. This required the careful use of high power and it appeared that some candidates only viewed the slides on low power. This limited their ability to gain the marks and many stated the cells were blue black when it was the starch granules inside the cells which were blue black.

(ii) Some candidates appeared to have missed this question and it is important that candidates continue to 'Turn over' when this appears at the bottom of the page as this indicates the question paper has not finished.

A pleasing number of candidates realised that the iodine was staining the starch and that the potato cells showed the presence of more starch than the leaf cells.

BIOLOGY

Paper 9700/33
Advanced Practical Skills 1

General comments

The majority of Centres returned the completed Supervisor's report, but in a very few cases the report was not enclosed with the candidate papers. Centres are reminded of how important it is that the Examiner receives the report with each packet of scripts, so that candidates are not penalised for any problems encountered with the practical.

In a few cases it appeared that the confidential instructions had not been seen before the day of the examination. For the candidates, the materials and apparatus required are vital to the success of the examination and thus it is important that entries are made early so that the confidential instructions are received in good time.

Although it is essential that these instructions remain confidential and are not left anywhere where a candidate may see them, they should be available for use prior to the examination. It is possible that, for biology practicals, the Centre may be required to germinate seeds or try out reagents.

However, without prior knowledge of the requirements a Centre will be penalising candidates because with many biology experiments checking for example that the yeast is active is essential. Centres are reminded that extra reagents and solutions should be available for any candidate who requests them. It is important for the confidentiality of the examination that these reagents and solutions are only labelled as in the confidential instructions and thus the examination paper.

The question papers must not be opened prior to the start of the examination; any checks which are required prior to the examination will be included in the confidential instructions. Therefore it is important that the Centre does not make changes, either to the quantities or apparatus, without prior consultation with CIE as this may lead to changes which make it impossible for the candidates to fulfil the requirements for the skills being assessed.

Any materials supplied by Cambridge will be listed in the confidential instructions and if this includes a prepared microscope slide the Centre should arrange for the slides to be checked for their condition and that it is the correct slide. The material is confidential and should not be viewed prior to the examination. Slides are sent on the basis of one slide for two candidates, with a few spares as the syllabus states that the number of microscopes expected is one for every pair of candidates. To enable each candidate to complete the activity needing the microscope, Centres should make sure that each candidate has sole use of the microscope for 55 minutes. The organisation within each Centre varies depending on the number of candidates and the facilities available.

Whilst Cambridge will continue to send out eyepiece graticules until 2012 it is expected that Centres should supply microscopes fitted with an eyepiece graticule. To enable candidates to draw the correct proportions they should be familiar with using the eyepiece graticules when drawing specimens from slides.

It was very pleasing that many candidates demonstrated that they had a good understanding of the skills required. There was good discrimination between the weaker and more able candidates, some of whom were able to score over 30.

For **Question 1** it was expected that candidates should use their knowledge of food tests to carry out the instructions. However, a few candidates did not know the methods for the food tests and so were unable to complete the activity correctly.

Candidates should be told that as stated at the beginning of the question paper that all they are expected to do is to follow the instructions and record what they see happening. Thus Centres should not try to 'make

the experiment work' as this will make it more difficult for their candidates to select a significant error and in some examinations provide modifications.

For obvious reasons of the variability in world situations data analysis or graph questions using the results of the candidate's own experiment are not set and the skills are assessed on common data so no candidate is disadvantaged by their own lack of results.

The syllabus shows that this component has a microscope activity and it gives the required specification for the microscope lenses. The examination questions are based on the use of an eyepiece lens of x10 with the appropriate x10 or x40, if higher power lenses are provided this may make it more difficult for the candidate to view the required section or cells which they need to draw without having to move the slide.

Candidates need to be familiar with using a microscope at low x10 and high x40; if additional lenses are present then they should be removed for the examination.

It is not acceptable for candidates to be given help to use the microscope as the use of the microscope is one of the skills being assessed. However, if a microscope is found to be faulty this should be replaced or extra time allocated for the candidate to complete the activity on another microscope.

Centres are reminded that this paper is skills based and that candidates should be made aware of the possible skills that will be assessed. These skills are clearly explained in the syllabus, for example graph plotting. It was pleasing that many candidates were able to demonstrate that they have developed the skills as part of their course and were able to adapt their skills to unknown investigations and use unfamiliar material.

There was some evidence that candidates were failing to gain marks because they answered questions as if they were from a previous paper. For example, the questions which ask for the errors in an investigation will expect the candidate to select the most significant errors for that specific investigation. Those candidates who have the opportunity to develop these skills as part of their course are more able to adapt to the requirements in the practical examination and gain more marks.

Comments on specific questions

Question 1

(a) (i) The candidates were asked to complete the pre-drawn table to show how the tests on each solution were to be carried out. While many candidates understood what was required, some candidates mistakenly, tried to forecast the results for the five solutions, **S1**, **S2**, **S3**, **S4** and **S5**. While the candidates were not penalised for this, time was lost recording information that was not required.

The most common mistakes were

- not stating or stating a volume of Benedict's solution less than the volume of the sample.
- not stating the temperature at which the Benedict's solution and sample solution was heated. The solutions should be heated to a temperature of at least 80 degrees Centigrade.
- not stating a specific time for heating the Benedict's solution and sample solution.
- failing to state the original colour of each reagent.

(ii) It was pleasing that many candidates organised the table clearly to show observations of the tests on all the solutions. Many candidates gained the marks available for drawing all the lines separating the 'cells' and for the correct headings. A common mistake was not including, as a heading 'observation (of colour change)'. In addition, some candidates did not record observations for all the solutions and did not gain the mark available. Many candidates gained the marks available for stating the correct colour changes for **S3** (starch), **S2** and **S3** (reducing sugar) and for all the protein tests on the solutions, **S1**, **S2**, **S3**, **S4** and **S5**.

(iii) A pleasing number of candidates gained the mark available for stating correctly the two solutions that should be mixed in equal volumes to provide the correct mixture to feed the young mammal.

(b) (i) The graph should have been drawn with time on the x axis. Some candidates did not gain the first mark because they did not include the units for both axes or placed time on the y axis. However, even these candidates could have gained the remaining marks if the scale used for both the x and y axes used more than half the grid, the points were plotted exactly and the points connected with straight lines or a smooth curve through all of the points. The data could have been plotted as a histogram, with blocks of even width, and blocks for day 1 and day 2 shown together to aid comparison. Those candidates who plotted the data as a histogram often gained the four marks available.

Some of those candidates plotting the data as a line graph were not careful in placing their cross or dot in a circle exactly at the correct point. Crosses or dots which are too large will not be given credit and there is some concern that crosses which are too small are lost when the line is drawn. If the Examiner cannot clearly see where the point is plotted then credit cannot be awarded. As a guide the length of each of the four arms of a cross should be no longer than 1 mm from the intersection. Each of the two intersecting lines should be no more than 2 mm long.

A dot should not be more than 1 mm across. The line used to connect the points should be thinner than 1 mm the use of a sharp pencil means that this should not be a problem and full marks for the graph would be expected.

(ii) Those candidates who understood what the data represented scored well for this question. However, it was clear that some candidates did not understand what the investigation was about. One mark was available for stating that the number of individuals that completed the digestion of starch in a short time initially went up and then the number of individuals that completed the digestion of starch in a longer time went down. A mark was awarded for quoting data with reference to time and number of individuals. If the candidate had changed the data to a mean number of individuals the Examiner required that this manipulation of the data be explained somewhere in the candidate's answer. The third mark was awarded for stating that digestion was faster on day 2 compared to day 1, or an equivalent answer.

(iii) Most candidates were able to suggest a suitable reason for the difference between the results for day 1 and day 2. Examples of suitable suggestions were

- the actual time that the mammals were fed varied
- volume of saliva taken form each mammal was different
- day temperature varied

Some candidates used the term 'amount' rather than volume and did not gain the mark available for stating the 'volume of saliva' was not constant.

(iv) While some candidates correctly stated three ways to control the variables in the investigation other candidates found this part of the question difficult.

Examples of suitable suggestions were
- the mammals of different species were of the same age or mass
- the mammals were fed at the same time of day or on the same diet
- the mammals were kept in the same conditions
- the same number of individuals should be used
- the volume of saliva should be the same each time or the volume of starch should be the same each time
- the temperature of water-bath should be constant or buffer used to keep pH constant

Question 2

(a) (i) It was encouraging that many candidates used clear, sharp unbroken lines to carefully draw the plan diagram of a suitable size, which should fill most of the space provided. Those candidates who used blunt pencils for the drawing lost marks. Candidates should draw their plan diagram to fill most of the space provided.

The majority of candidates drew the correct section as shown by the shaded area. Those candidates who took the time to draw the bulge at the bottom of the midrib, the region of cells at the tip, the vascular bundle in the lower half of the midrib gained the marks.

Many candidates labelled the upper surface and one vascular bundle as required.

(ii) Most candidates were able to describe a visible adaptation of the leaf and a possible advantage to the plant. Visible adaptations described included curling of the leaf, the presence of a cuticle and stomata confined to the lower surface of the leaf. Advantages to the plant included reduction of water loss and trapping water as ways of conserving water.

(iii) The marks were not for the correct answer but for showing all the steps in the calculation. It was pleasing that most candidates gained the mark available for showing that the midrib measurement was larger than the lamina measurement. When recording a ratio it is conventional to express the ratio as stated in the question, in this case with the midrib measurement first followed by the lamina measurement. A mark was awarded for showing both values as whole numbers in the final answer.

(b) (i) It was encouraging that some candidates were able to gain three or more marks. As the candidates were required to draw a group of three cells from the upper epidermis and the cells touching them it was expected that candidates would take the time to carefully draw the shapes and sizes of the cells. The three epidermal cells drawn needed to be in contact to gain the mark available. Candidates should be encouraged to use double lines for the cells walls as this enables the thickness of the cell walls to be shown. It was disappointing that some candidates did not follow the instruction to label a cell wall.

(ii) It was pleasing that many candidates organised the table clearly to show the observable differences between the upper and lower epidermis of the leaf.

By including a column with the heading ‘feature’ candidates gained the marks available more easily as it was clear to the Examiner what feature was being compared. Features gaining marks included the surface of the leaf, cell shape, the thickness of the cell wall, the number of cells packed together, the distribution of the trichomes, the distribution of the stomata and the presence of the cuticle.

BIOLOGY

Paper 9700/41
A2 Structured Questions

General comments

The spread of marks was reasonable and the paper as a whole discriminated well.

A major concern, even from otherwise good candidates, was the inability to read carefully the command words in a question, such as *describe*, *explain* or *suggest*, and then answer the question appropriately. The largest error was in answering comparison questions. When asked to compare two parameters from a graph, every sentence should state a comparison. Candidates should not just give figures and leave the Examiner to decide whether one is larger or smaller than the other. This occurred in **Questions 3**, **5** and **8**.

The ability of candidates to apply their knowledge in novel situations or to analyse stimulus material is a very important skill to possess when answering parts of this paper. Candidates should be encouraged to practise many of questions of this type. Many candidates performed well on questions that required recall, particularly in **Question 9**.

Comments on specific questions

Section A

Question 1

(a) Many gave a good definition of the term *endangered species*, particularly that there would be very low population numbers and there would be a risk of extinction. Only the best candidates also mentioned that because of the very low numbers, reproduction was no longer sufficient to maintain numbers.

(b) Most candidates were comfortable in providing several methods of protecting the squirrel monkey and consequently this question was well done.

Question 2

(a) It was hoped that a description of a typical population growth curve, with explanations regarding its shape, would be described. Unfortunately, many were unable to do this and a surprising number of candidates tackled the whole question in terms of evolution and adaptation. Good candidates were able to show that there would be an exponential phase, stationary phase, death phase, etc. However, many lost marks by simply saying the population grew, with no reference to a rapid growth of the population, and simply referred to the fact that "conditions were favourable for the population", without giving any detail such as plenty of food or other resources.

(b) The main problem with this question was the failure of many candidates to talk about phenotypic variation, and describe genotypic variation instead. Weaker candidates just used the phrase "survival of the fittest" without giving any explanation.

Question 3

(a) (i) Most candidates were credited for this but a few failed by talking about denaturation of bacteria or killing of enzymes.

(ii) On the whole this was well done, but quite a lot of candidates failed to mention that it was sodium alginate and calcium chloride, or mixed up the two. Some added the solution in the wrong order and only the best candidates mentioned calcium ions displacing sodium ions to precipitate the beads.

(b) (i) This graph had been printed in colour so that candidates could quite easily distinguish between the three lines. Some did not take advantage of this facility and mentioned the cells in agar or described the wrong two lines. Even good candidates seem incapable of comparing. Each sentence needed to state a comparison and just describing what happened to each medium in turn did not score any marks. Nevertheless some candidates were able to mention that the two lines increased initially and were able to quote paired figures from the graph. Others went on to show that the free cells ended up with a higher concentration of protease than the cells in the beads.

(ii) It was hoped that candidates would be able to apply their knowledge of biology to suggest reasons why the cells in agar produced less protease than the cells in the beads. Many mentioned the fact that the beads would provide a larger surface area for the reaction to take place, but hardly any stated that the substrates would take longer to reach the centre of the cubes or that the agar may be less permeable to the substrates than the beads.

(c) (i) It was very disappointing to note that very many candidates were unable to perform this fairly straightforward calculation and clearly this is something that would benefit from extra practice.

(ii) Most candidates were able to say that the alginate cultures produced more protease, but only a minority were able to show that because the fermentation went on for longer there would be less time wasted preparing the beads and less time wasted between fermentations. Questions like these expect an answer in terms of the information given in the question, sometimes backed up by other biological knowledge that the candidate should already have.

Question 4

(a) It was pleasing to note that almost all earned credit.

(b) Very few mentioned anything about the lack of homologous chromosomes or the inability of chromosomes to pair at meiosis 1. Most candidates simply went into detail paraphrasing the question, which brought them no marks, and very few appreciated that the plants would not be able to form gametes at all.

(c) Hardly anyone gave the standard definition of a species, being able to interbreed to produce fertile offspring, which was required here. Many incorrectly mentioned that the plants could not be the same species because they did not have the same genetic content.

(d) This should have been a simple explanation of speciation due to geographical isolation. Most candidates lost marks by not mentioning the geographical barrier at all, and by not understanding accurately just what was being separated by it. Some of them incorrectly thought that it was species rather than populations being separated by the barrier, whilst others talked about single individuals. Very few mentioned that it is populations or groups of the same species that are separated. Many candidates noted that there would be different environments or selective pressures on either side of the barrier. Some thought that selection acted on the alleles directly, not on the features or the phenotypic characteristics. Surprisingly few mentioned the change in allele frequencies, a point that has been well understood in past papers, but were able to state that over time the two groups would be unable to breed and therefore would be different species.

Question 5

(a) Most candidates were able to state that endocrine glands were ductless and released their products directly into the blood.

(b)(i)(ii) Unfortunately, many failed to mention that the follicles would be developing, although some did state that oestrogen would be produced and that LH stimulated ovulation.

(c) Candidates are expected to know the details of the IVF procedure and the reasons for each stage so it was disappointing to see that very few were able to show that FSH is given so that many oocytes could be harvested at the same time. many candidates incorrectly used the words "ovum" or "egg" when they should have known that it is the secondary oocyte that is released upon ovulation.

(d) (i) Negative feedback has been tested many times in the past and produced a wide variety of answers. It is worth noting that all responses should really refer to a return to a "norm" or "set point" as a minimum requirement in answering this question.

(ii) This was a high level question as it required candidates to link two known facts in a slightly novel situation. Consequently only the more able candidates were able to show that FSH inhibition would be blocked.

(e) (i) Very few managed to place the asterisk correctly and a large minority failed to place an asterisk at all.

(ii) Most candidates who had earlier in the question correctly stated that LH caused ovulation were unable to say that an antagonist to LH would, in fact, stop ovulation. A very small number of candidates got this right.

(f) It is pleasing to note that many were able to show that the standard treatment produced more oocytes and embryos, and many quoted figures to support this. Very few noticed that there was little difference in pregnancies resulting in live births.

(g) Only the better candidates were able to show that promoters were needed to ensure that the genes were "switched on" in order to produce the correct protein. It was rare, however, to see a reference to the fact that a eukaryotic gene had been placed in a prokaryotic cell.

Question 6

(a) (i) Most candidates were able to state that both the fetus and the first child had an identical band of DNA in the electrophoresis gel.

(ii) Very few gained marks by referring to the process of electrophoresis. It was expected that candidates would mention that, as there had been a deletion, the mutant DNA would be shorter or lighter and would therefore travel further in the gel. Credit was given for those who stated that the first child and the fetus had a band missing.

(b) The two most commonly given answers related to the need for the test to be explained by the counsellor and that termination may be an option. Very few candidates mentioned gene therapy or the improved drugs now available.

Question 7

(a) It was pleasing to note that many candidates were able to define genetics terms accurately.

(b) On the whole candidates were able to produce good answers. Unfortunately a small number either treated the question as monohybrid or sex-linked and scored no marks.

(c)(i)(ii) Most candidates were able to complete the table and use it to work out chi-squared correctly.

(ii) Many candidates used 0.5 for the value rather than 0.05, and then went on to say that the difference was significant, whereas others stated that the differences were not significant and due to chance. It seems that many candidates have a poor understanding of how to use the value of chi-squared once they have calculated it.

Question 8

(a) (i) Unfortunately many candidates either commented on both experiments or on experiment 2. Those who did as asked usually scored full marks.

(ii) Many gained marks by referring to the increased concentration of carbon dioxide in experiment 2, and the increased rate of photosynthesis. Others wrote about light intensity and carbon dioxide being limiting factors but did not indicate where they were on the graph.

(b) Many candidates realised that the question was about enzymes and denaturation and that RuBisCO would be involved. The increased possibility of photorespiration was also mentioned as a reason for the reduction in the rate of photosynthesis. Some candidates stated that with the closing of stomata, due to increased transpiration, this would reduce the uptake of carbon dioxide for the light independent stage.

Section B

Question 9

(a) Glycolysis is well understood and many candidates got almost full marks for this part. Most were able to show that glucose would be phosphorylated twice to form a hexose bisphosphate and that this would split into two molecules of triose phosphate. The triose phosphate would be dehydrogenated to pyruvate and that ATP would be formed. The most commonly missed points were that phosphorylation of glucose results in its activation, that a 6C sugar is split into a 3C sugar and that there is a total ATP gain of four molecules or a net gain of two ATP from one glucose molecule.

(b) Many candidates wrote a lot about the structure of ATP or its synthesis or its role. Only the better candidates were able to accurately describe all three. A lot of information given was irrelevant and did not answer the question. A good answer noted that ATP was a nucleotide made of adenine, ribose and three phosphates and that it could release energy when the terminal phosphate was released. ATP can be made during glycolysis, Krebs cycle and a number of other ways. Many were able to give a good use of ATP, notably muscle contraction and active transport.

Question 10

This was the less popular of the two questions in *section B*.

(a) It is apparent that many candidates who answered this did so by using knowledge that is below what is expected at A Level. The descriptions of the reflex arc were lacking in detail and in many cases unscientific, for example the word “message” was commonly used for action potential.

(b) Candidates who had learnt the neurophysiology section were able to give a good account of the myelin sheath and its role, often giving very accurate and concise answers. A good answer here was able to describe that the myelin sheath was due to Schwann cells consisting largely of lipid wrapping around axons and insulating them. Ions would not be able to pass through except where there were gaps or nodes and that the speed of transmission of the impulse would increase as the action potentials move by saltatory conduction.

BIOLOGY

Paper 9700/42
A2 Structured Questions

General comments

The paper differentiated well between candidates throughout the mark range offering a range of both straightforward and more challenging questions. It was evident that many of the candidates had been well prepared for the examination, with able candidates achieving maximum marks in many sections of the paper. Candidates usually attempted every section.

It needs to be emphasised that reading the question carefully and noting the salient aspects of it is essential to ensure success. Responses needing description and explanation often only satisfied the describe element. Candidates usually quoted figures where data had been provided, however, figures alone should not be regarded as a substitute for descriptions or explanations.

Both free response questions proved popular, with excellent knowledge of part **(a)** in both, while part **(b)** discriminated well between candidates.

Comments on specific questions

Question 1

Very few candidates gained full marks. Apart from the plant and animal kingdoms, responses reflected an insecure knowledge of the features possessed by living organisms.

Question 2

(a) Most candidates recognised the geographical barrier or the mountains as the isolating mechanism. The majority also realised that this was allopatric speciation.

(b) There was usually an attempt to describe the mountains separating the populations, although often individual mice seemed isolated rather than separate groups. Most noted that different selection pressures would operate and genetic change would follow. It was rare for responses to mention mutations or different chromosome numbers **arising** in these circumstances. Far too many candidates referred incorrectly to the separated groups as new species before genetic changes had occurred.

Question 3

(a) (i) Surprisingly, this was not always recognised as condensation.

(ii) The mode of action of antibiotics on bacteria was usually well known. The role of autolysins creating holes in cell walls during growth and penicillin preventing the formation of cross links was frequently described, together with the weakening of the cell wall leading to cell lysis.

(iii) Credit was given for noting that this was a peptidase. Some candidates qualified this incorrectly naming a peptidase other than glycoprotein peptidase.

(b) While the lack of a cell wall was well known, reference only to a lack of cellular structure was regarded as insufficient.

(c) The higher peptidoglycan content of the wall was most commonly noted. The lack of an outer membrane for protection so that the penicillin can reach the wall directly could also gain credit here.

(d) Candidates usually noted the increase in resistance throughout the time period and quoted suitable figures. Many successfully described how mutations could result in a resistant allele arising and being passed to other bacteria (via horizontal or vertical transmission). Only a few responses referred to misuse of antibiotics or the production of beta-lactamase which would break down penicillin.

Question 4

(a) (i) Candidates should be encouraged to notice general trends rather than simply listing figures for each soil type and crop. Good responses made clear comparative statements between sorghum and wheat or between the yields in HWC and LWC soils. Marks could then be awarded for supporting figures provided that correct units were given. Better candidates also explained the results in terms of structural features of sorghum that adapt it to an arid environment.

(ii) Control of wind, soil pH, fertility, seed numbers or density were all possible answers, but few candidates gained full marks.

(b) Well prepared candidates were able to describe the roles of bundle sheath cells and mesophyll cells in preventing oxygen from reaching RuBisCO or RuBP. However, details of the Hatch-Slack pathway alone were often supplied without reference to how photorespiration was prevented. Very few references were made to enzymes having a high optimum temperature.

Question 5

(a) **B** was usually identified as the seminiferous tubule.
A proved more difficult to identify as a Leydig cell or interstitial cell.

(b) (i) Most recognised this as division 1.

(ii) Cells E, F or the spermatozoan were all commonly listed.

(iii) This was less well known as a growth stage.

(c) Many candidates described the spermatozoan as needing energy but failed to link this to the mitochondria. A frequent error was to state that energy was 'produced' rather than being provided. Only a few responses mentioned the flagellum as the part needing this energy. Vague references to 'tails' are inadequate at this level.

(d) (i) This was well known, often achieving maximum marks.

(ii) Few candidates used correct terminology such as 'oocytes' when describing fertilisation, or named suitable glassware to explain 'in vitro'. References to test-tube babies alone are unacceptable at A Level.

(iii) This was generally poorly answered although full marks could be gained by describing implantation as being less likely, the increased chance of miscarriage or changed levels of hormones. Candidates often described fewer oocytes being produced instead of correctly noting that fewer might be released. Better answers noted the increased possibility of genetic defects.

Question 6

(a) (i) The islets of Langerhans plus alpha and beta cells were usually mentioned, together with the role of the blood in carrying away the hormones. Rarely was the endocrine tissue actually described as being scattered throughout the pancreas.

(ii) While insulin was identified as protein by many, its precise globular nature was rarely noted.

(b) Candidates had little difficulty describing three advantages for maximum marks.

Question 7

(a) The idea of 2 heterozygous or carrier parents producing a homozygous recessive child was well understood. The chance of this happening was also included in many responses but reference was rarely made to possible mutations. A few candidates described a sex-linked inheritance despite the condition being clearly stated as due to an autosomal allele.

(b) (i) Some responses confused this with the production of monoclonal antibodies. However, many correctly understood this to involve gene engineering, or clearly described the process.

(ii) Most responses were correct.

(iii) A low blood glucose concentration was identified correctly by many, some using an example such as 'during exercise'. Vague statements that did not mention blood or glucose did not gain credit.

(c) It was mostly understood that these were foreign and would initiate an immune response. Other answers described their role in cell recognition, although often they were incorrectly referred to as receptors.

(d) The majority gained full marks although a few only gave one set of gametes instead of two. Candidates need reminding that offspring phenotypes should always be positioned to correspond with the appropriate genotypes.

(e) This proved to be a discriminating question. Candidates must be encouraged to look for the most obvious differences in data. In this case the allele frequency of the Canadian Inuits was considerably different from all other populations and the L^M allele frequency was much greater than the other four populations. Minor differences between populations were completely insignificant. A few did attempt to explain this in terms of the L^M allele giving the Canadian Inuits a selective advantage in their environment, another possible reason being more inbreeding in the isolated Inuit population.

Question 8

(a) The adaptations were well known.

(b) Most candidates were able to calculate the light intensity correctly.

(c) It was generally recognised that photosynthesis would occur, producing oxygen, and most realised that the gas would accumulate causing a reduction in density or an increase in buoyancy. Some candidates, however, incorrectly referred to loss of mass as the cause of the discs rising.

(d) The relationship was clearly described by the majority of candidates. Paired data quotes were needed to gain full marks.

(e) It was appreciated that light was no longer the limiting factor and that carbon dioxide probably was. Rarely was reference made to the heat of the lamps creating too high a temperature that would denature enzymes.

Question 9

(a) Many candidates gained full marks for a detailed description of the cycle. Most noted that it occurred in the mitochondrial matrix and described decarboxylation, dehydrogenation and ATP formation. Common omissions were the involvement of enzymes and the idea of substrate level phosphorylation.

The inclusion of details of events leading up to the formation of acetyl coenzyme A was not necessary and candidates should be reminded not to waste time on irrelevant material.

(b) The role of NAD as a hydrogen carrier and its significance for ATP synthesis was generally known, but some responses only referred to the carriage of hydrogen ions with no mention of electrons. Its role carrying hydrogen from glycolysis and the Krebs cycle was usually described, although its role in relation to the electron transport chain led to many inaccurate statements. Few candidates commented that it is a coenzyme for dehydrogenase. Many irrelevant details of chemiosmosis were seen.

Question 10

(a) This proved highly accessible with well prepared candidates gaining maximum marks. Marks were frequently lost, however, through careless use of terminology and a failure to state exactly where events are happening in synaptic transmission. A common error was the omission of reference to the presynaptic membrane in relation to the arrival of the action potential or calcium ion movement. There were also many incorrect references to ions entering 'membranes' rather than 'neurones' and vesicles being released instead of the neurotransmitter. Overall the sequence of events was well known.

(b) Good candidates had little difficulty gaining maximum marks. One way transmission was usually mentioned but was not always explained in terms of receptors only being in the post synaptic membrane, or vesicles only being in the presynaptic neurone. Most recalled their importance in memory, due to new synapse formation and the possibility of a wide range of responses. Ideas of summation, discrimination or adaptation were confined to a few of the best candidates.

BIOLOGY

Paper 9700/51

Planning, Analysis and Evaluation

General comments

It was pleasing to see evidence that more candidates have experience of practical work which they were able to apply to novel situations. However, candidates should still be reminded to read questions carefully so that they ensure that they answer the question being asked. This was particularly true in **Question 1** where the majority of candidates answered only in terms of the total photosynthesis, rather than the light dependant stage of photosynthesis.

Comments on specific questions

Question 1

Overall the answers to this question were limited. Candidates showed a basic understanding, but were unable to apply their knowledge of photosynthesis to this question.

(a) (i) Although many candidates gave correct axes, the majority did not sketch a suitable curve. The most common graph was a version of the standard curve for effect of temperature on the overall rate of photosynthesis. This would seem to indicate that either candidates had not read the question carefully enough or had not recalled that the light dependent stage of photosynthesis is temperature independent.

(ii) Most candidates identified one correct variable, most commonly the light intensity. The only other common correct responses were concentration of electron acceptor and concentration of chloroplasts. Answers that used 'amount' of light or electron acceptor were not credited. Candidates should be encouraged to use precise terms when referring to quantities. Common incorrect responses were carbon dioxide concentration, pH and temperature.

Relatively few candidates were able to explain how any the variable could be controlled. Answers were often too vague, for instance, 'keep the light the same' or in some cases not practical, for example, 'count the chloroplasts'.

(iii) Candidates often wasted time here by repeating the experimental procedure. Only better answers referred to recording the time for the indicator to change for blue to colourless. Very few candidates explained how the time could be used to calculate the rate.

(b) Very few candidates gave a correct response. Most of the answers were a description of the role of ADP and inorganic phosphate in photosynthesis.

Question 2

This question was about interpreting data about cell population growth. Candidates often made basic errors in calculations and did not use the same significant figures as in Table 2.1. Many candidates did not seem to be familiar with interpreting sample data and consequently could not extract suitable data to answer the question.

(a) Answers were quite variable and most candidates gained at least 1 mark. In some cases candidates were able explain the purpose of the control but did not identify it. In other cases the control was identified but the explanation was too vague. The statement 'for comparison' without any further explanation was not credited.

(b) Most candidates gained one mark for counting the cells. Many candidates were clearly unfamiliar with counting grids. Although they realised that the volume had to be calculated, these candidates could not identify which of the dimensions to use. Although 0.2 mm x 0.2 mm x 0.1 mm was expected, credit was given if candidates explained how to the calculate volume of any of the grid divisions shown. Candidates who had experience of using these grids usually gained all the marks.

(c) (i) Most candidates were able to calculate the percentage correctly. A common error was to give 6.18 instead of using the same significant figures as in the table.

(ii) Many candidates gave a correct answer. Candidates who carried forward their answer of 6.18 from **(c) (i)** were given credit for an answer of 106%. There were also a number of candidates who did not seem to know how to work out a percentage increase and used two values from Table 2.1 in their calculation. In some cases these were sample 1 and sample 10 of the control culture and in other cases the values for sample 10 of the experimental and control cultures.

(d) Few candidates answered this question well. A common error was to treat the sample data information as pairs, when in fact they are simply samples taken from different cultures and counted. Candidates did not seem to understand that a number of samples had been taken at the same time in order to obtain a mean so that the numbers were just a way of labelling for each of the series of samples.

(i) Most candidates correctly referred to the difference in the mean value or to the difference in the percentage increase in the two populations of cells. Only better candidates considered the range of the data and recognised that both the bottom and the top end of the range was higher for the experimental data.

(ii) Very few candidates gained any marks in this section. Most of the answers compared samples by number; the most common being numbers 3 and 10. This reflects that again, candidates did not consider the range of data for each of the growth conditions and recognise that there was some overlap as well as great variability within the ranges.

Question 3

This question expected candidates to apply their knowledge of data collection to an unusual situation and to evaluate data. As in previous examinations, many candidates are still uncertain about statistics

(a) (i) Most candidates were unable to suggest a suitable method of measuring, even though the question referred to mass. The majority of answers were too vague, for example 'measure the size of the body and the testis'. Some answers were inappropriate, for example counting sperm. Many candidates described an experimental set up with some fish exposed to PCBs and others not exposed. This was not necessary as fish can be collected from their natural environment and the concentration of PCBs in the water measured. Although candidates often referred to a ratio, this was not credited unless there was an explanation of how to calculated the ratio.

(ii) The majority of candidates incorrectly stated chi-squared test. Candidates should be aware that data which is a continuous variable, such as measurements of body size, cannot be compared using chi-squared test. Candidates who did correctly refer to *t*-test were often unable to give an explanation. Centres would be well advised to ensure that candidates understand the type of data that can be analysed by chi-squared test and by *t*-test.

(ii) Almost all candidates gave a correct answer.

(b) Most candidates correctly recognised that increase in CB-153 increase DNA damage, but did not extend their answer any further. Poorer answers tended to be a description of the graph.

BIOLOGY

Paper 9700/52
Planning, Analysis and Evaluation

General comments

There was a good range of responses covering the majority of the mark range. It was good to see that Centres had often taken note of previous comments in preparing their candidates. However, it is still important to remember that this paper requires the development of the cognitive skills of the candidates not just rote learning. Examiners commented that there were places where candidates seemed to be trying to apply a previous mark scheme to a novel situation. Many candidates still seem to be uncertain about the use of statistics.

Comments on specific questions

Question 1

This question was about identifying variables and analysing data from population growth in different conditions.

(a) The commonest error was to cite temperature. Careful reading of the question should have allowed them to avoid this slip as the temperature is changed during the course of the experiment. It was good to see fewer methods of control referred to in vague terms such as 'amount' or 'quantity'. Some weaker responses referred to controlling 'the culture' without making it clear whether it was the nutrient or the bacteria that was being considered. Some candidates also thought the bacteria could be kept constant by counting them. Food was not accepted as an alternative to nutrient.

(b) The question was about the survival of immobilised cells in continuous culture. The comparison with free cells was only valid for Day 3. Many candidates did not gain the comparison mark or suggested survival of free cells was better until after Day 6; this is not something you can see as there is no data for free cells other than at day 3. The logarithmic scale was not a problem to the majority of candidates who were, in many cases, able to use figures to make a valid comparison. Weaker answers tended to quote figures without making the comparisons. The most common correct answers were a reference to the effect of time on survival and the greater survival of immobilised cells in gastric juice. Although the question asked only for a description of the results, some candidates tried to explain them as well.

(c) The responses here were very variable. Weaker responses stated the formula with no indication as to the meaning of the symbols or simply defined standard deviation. Many had the number of cells surviving rather than the mean of cell survival. Candidates found it difficult to express the idea of the number of samples for each condition tested. Many talked about the number of days.

Question 2

This question expected candidates to apply their knowledge of experimental design to a novel situation. It was not expected that candidates would have used a pollen collector, but would be familiar enough with field studies to devise a suitable procedure.

(a) There was a considerable range of responses. The better responses appeared to be from candidates who had some experience of sampling in the field and were able to apply this to a novel situation. Many candidates restated the information given in the question rather than thinking about the actual procedures to test the hypothesis. The information in the question indicates that this is a field experiment but many candidates seemed to have applied a laboratory based question on light intensity to this investigation. Thus the pollen trap was commonly set up in a dark room

with lamps at various distances from it. Often there was no mention of plants in the room. The Examiners allowed some credit in this case provided that there was at least one reading in the dark as well as differing intensities/lamp distances. There were good answers showing that candidates had field experience and were able to apply it. Most realised that the time interval needed to be standardised but were less good at keeping the location fixed. As far as counting the pollen grains was concerned, many just repeated the stem of the question rather than stating that the number is counted in the field of view, the area of which is calculated by using a graticule to measure its diameter and the standard formula used to calculate the area of a circle. Although many candidates referred to repeats, not all had at least two repeats, i.e. 3 readings in total, and many failed to mention taking a mean. Recognition that this was a low risk experiment earned credit. However, if hazards were mentioned there needed to be both the hazard and a precaution mentioned.

(b) There were a variety of ways that candidates tackled this, some even effectively doing 'back calculations' from the answer. Some candidates thought the question referred to how the mean number of 6 per field of view was achieved.

Clearly set out answers showed the total pollen collected and the volume of air in 6 hrs then divided the former by the latter. Credit was given for other acceptable methods provided the working was clear and valid.

(c) The change of conditions from light intensity to humidity was missed by even some able candidates, which emphasises the need to read the material carefully before answering.

(i) More candidates were able to state a null hypothesis than has been the case previously, but in some cases there was only a general definition which did not relate to the specific situation of varying humidity (dry and wet air). Just mentioning weather conditions was not enough. However, there were still a lot of responses giving the alternative hypothesis and Centres would be well advised to ensure that candidates clearly understand the difference and are able to apply them to the specific situation in any question.

(ii) Very few answered this in terms of the data being categoric. There were some good answers describing the use of the chi-squared test to see if the difference between the expected and observed values were significant. Less precise answers, for example, 'to see if the results were (significantly) different' were not credited.

(iii) Just stating that 2-1 = 1 was not enough. The candidates needed to show that they realised that 2 was the number of conditions that were tested, or to state the conditions as 'dry' and 'wet'. Some candidates incorrectly stated that the two conditions were dry and hot. A significant number were distracted by the number of pollen grains on the wet day, stating this as the 2 in the formula.

Question 3

This question was about recognising variable and experimental design.

(a) (i) Most candidates correctly identified the two independent variables as temperature and ethanol concentration. A few candidates gave incorrect control variables such as number of discs.

(ii) This was usually well answered as most of the candidates recognised light absorbance as the dependent variable. The commonest error was to simply state membrane permeability. This is two steps removed from the variable actually measured which is the difference in absorbance caused by the varying amount of pigment released. This is then used to suggest the change in membrane permeability.

(b) (i) Most candidates gained both marks here. Only a minority identified one or both values in the wrong table. The commonest errors were to identify 0.10 in candidate 5 at 20% or 0.35 in candidate 4 at 60%. Candidates who identified more than two values correctly gained full marks, but if the additional values were incorrect then a mark was deducted for each incorrect value.

(ii) Candidates did not really appreciate what was required in this question. Very few considered the design of the experiment and did not realise that for valid comparisons to be made the range of ethanol concentrations needed to be tested at each temperature. Many candidates simply discussed why the results were unreliable, often in terms of too few repeats or not a wide enough

range tested. These are inappropriate as there are 5 repeats and in answers about reliability, credit is given for a minimum of 3. The range of ethanol concentration goes from 0% to 100%. A few candidates showed an understanding of the idea that it not possible to compare ethanol concentration and temperature because there was not enough data, but then incorrectly related the lack of data to a lack of repeats. A lack of a statistical test was often given. This is not experimental design; it is results analysis after an experiment has been carried out.